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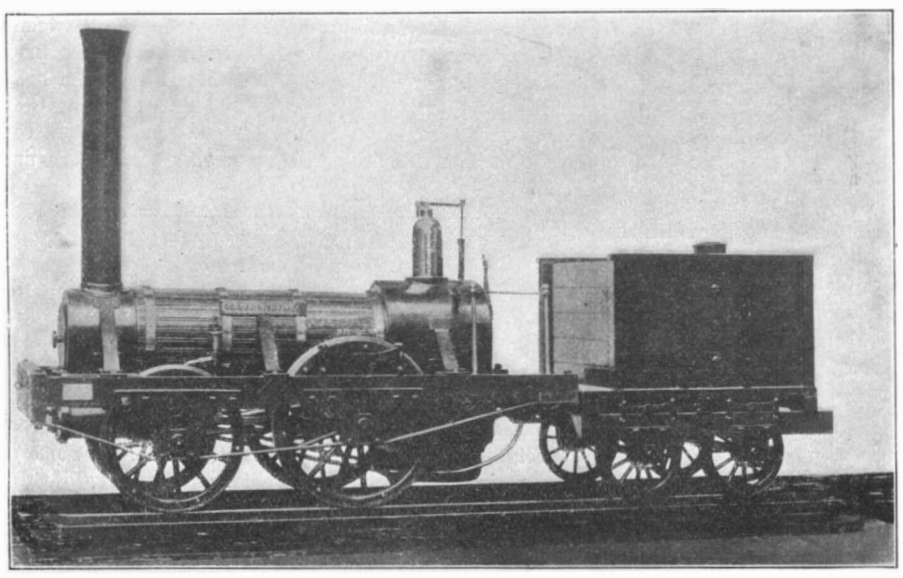
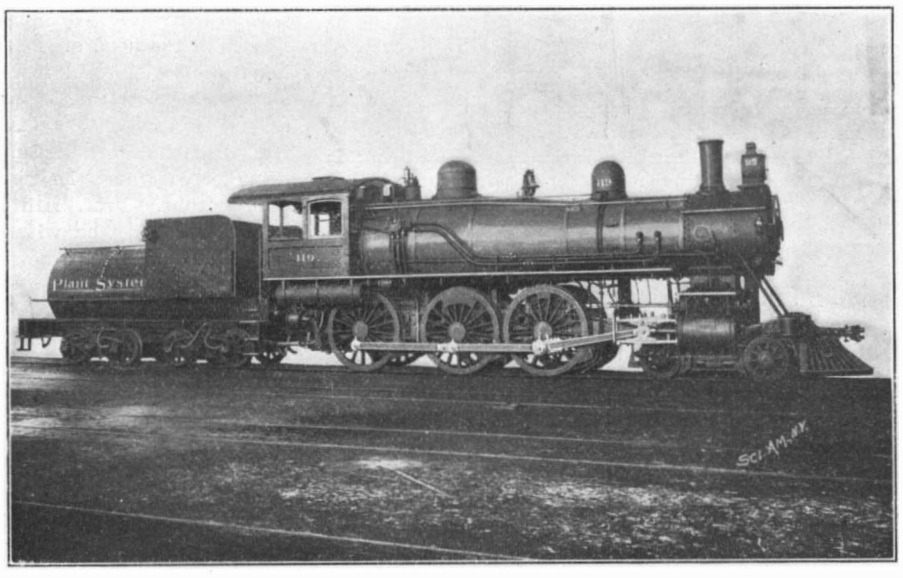


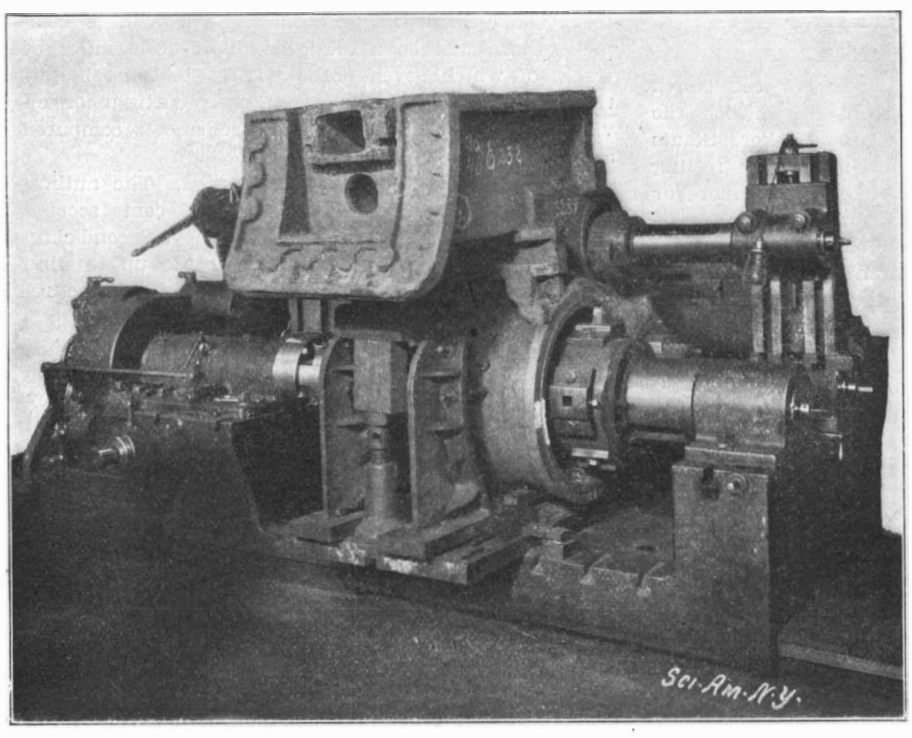
"Old Ironsides," 1832. The First Engine Built by Baldwin.

Two cylinders 9½ inches diameter by 18 inches stroke. Weight, 9 tons.



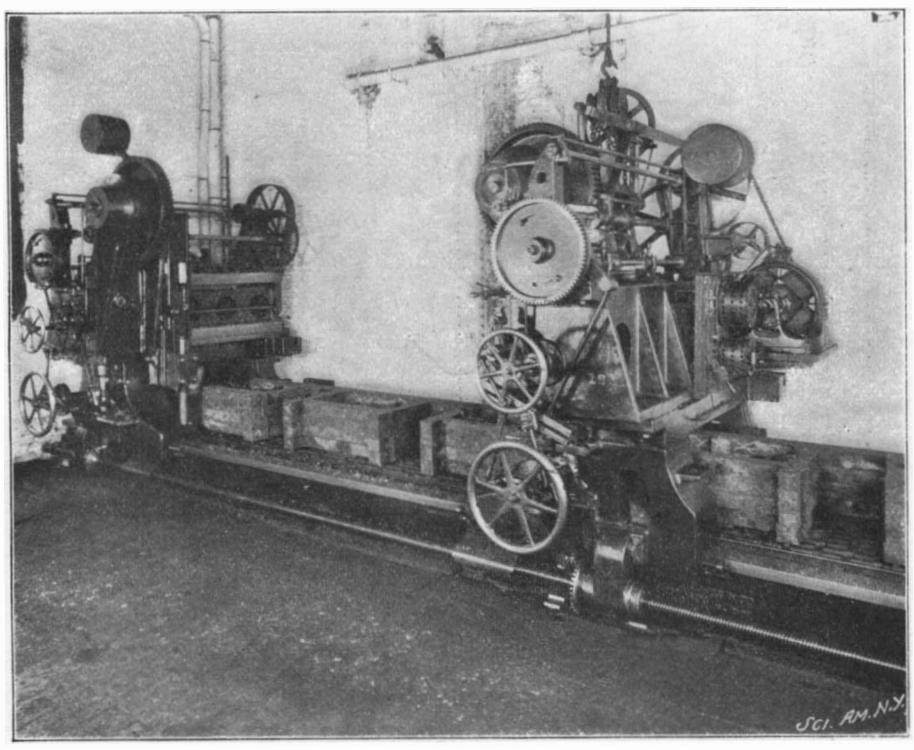
No. 20,000. Four-Cylinder Compound. Built in 1902.

Four cylinders 15 and 25 inches diameter by 26 inches stroke. Weight, 86 tons.

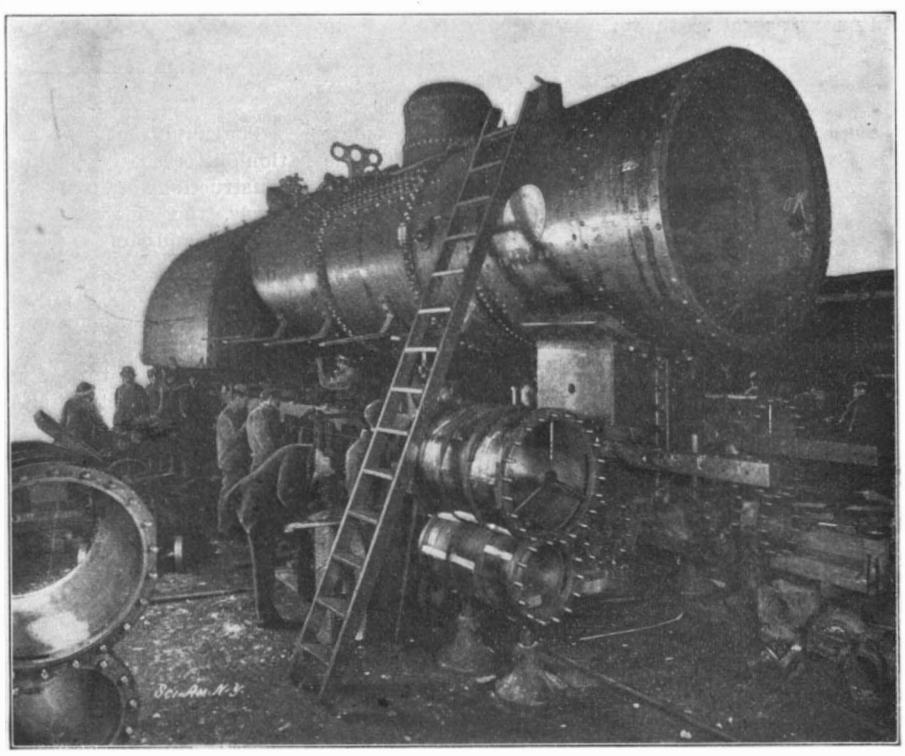


Special Machine for Simultaneously Boring High-Pressure and Low-Pressure Cylinders and Steam Chest.

The Foundry, Showing Flasks for Compound Cylinders.

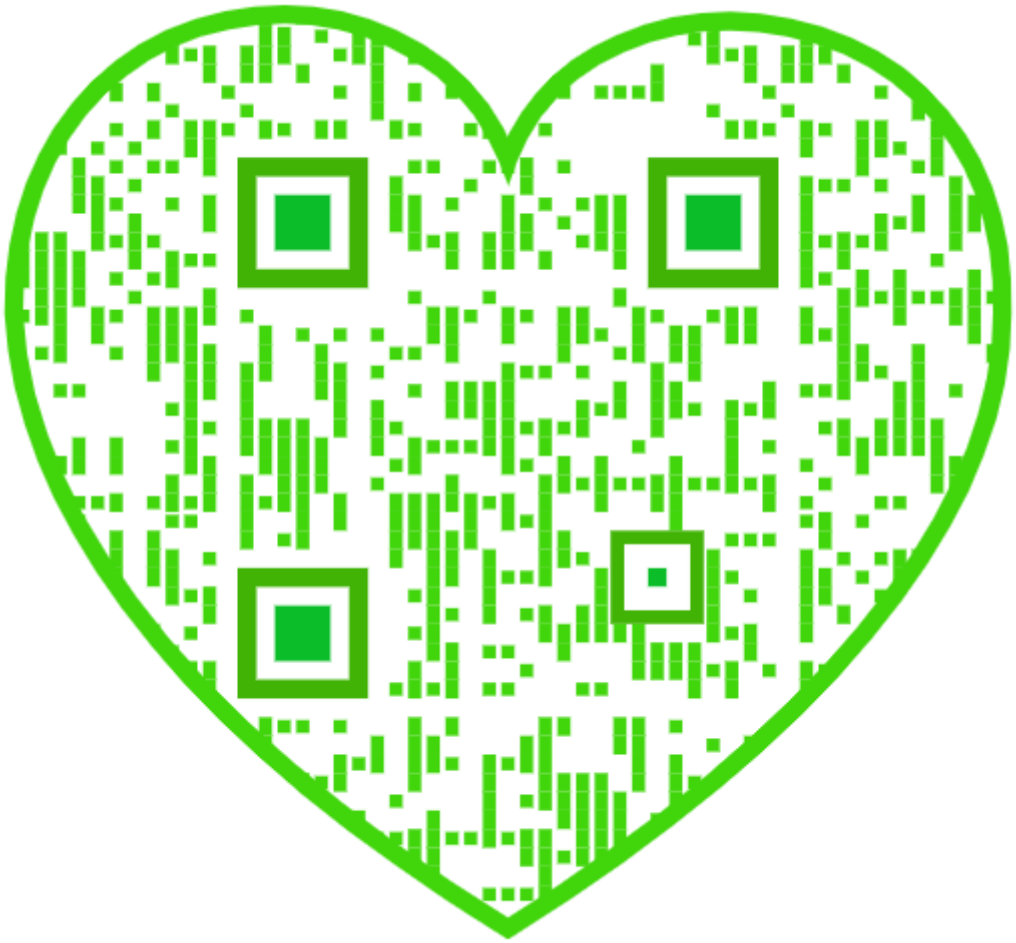


Double-Head Machine Slotting Two Pairs of Engine Frames.



In the Erecting Shop; Lining up the Cylinders.

THE BUILDING OF AMERICAN LOCOMOTIVES.—[See page 396.]



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NEW YORK, SATURDAY, JUNE 7, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

SEISMIC DISTURBANCES AND THE ISTHMIAN CANAL.

The question of the construction of the Isthmian Canal, assuming of course that considerations of a commercial and political nature have been disposed of, is first and last one of civil engineering. Were this canal to be constructed in a locality in which the conditions are normal, the problems confronting the engineer, while they might be more or less complicated, would yet be such as any first-class engineer or body of engineers could satisfactorily solve. In planning a structure of the magnitude of an inter-oceanic canal, the stability of *terra firma*, as such, would be one of the axiomatic assumptions upon which the whole work would be laid out; and it is certain that were it suddenly discovered that the very earth itself was liable to violent concussions, upheavals, changes of level, or changes of form by the deposit of so many cubic miles of material flung heavenward to descend as a solid rain or traveling for miles in the form of a molten or boiling torrent—upon such a discovery we can well believe that the engineer would consider that his problem was solved by being suddenly consigned to the region of the absolutely impossible.

We feel that the lesson of St. Pierre's disaster will have been very poorly learned if it does not lead to a more thorough examination of the seismic conditions along the two alternative routes of the Isthmian Canal, and in our issue of May 24 we drew attention to the fact that the recent eruption renders the construction of the Nicaragua Canal, which runs through a highly volcanic district, more unlikely than ever. Our remarks on this subject have called forth a protest from a correspondent, Dr. Eugene Murray-Aaron, which is published elsewhere in this paper. The writer, who reminds us that he speaks with authority as one having lived on the Isthmus, would have us believe that Panama is a perfect tempest of seismic convulsions, experiencing "sudden shocks and quivers that would crack the pyramid of Cheops in twain," and that Nicaragua, so far from being menaced, is positively protected by its volcanic surroundings. On reading his letter we must confess to a feeling that the Doctor proves too much. For, if earthquakes that would "crack the pyramid of Cheops in twain" are not an infrequent occurrence at Panama, how comes it that for close upon a half century there has been a railroad in continuous operation through that region from sea to sea? Either Cheops must be wonderfully fragile, or else the steel bridges, masonry culverts, and the embankments of the Panama Railroad must be possessed of a strength and stability beyond anything seen or even dreamed of in any other part of the world. The foundations of these bridges and other railroad structures do not "go down 150 feet below sea level," and yet they have stood these mighty perturbations to which the Doctor refers, for fifty long years, and they are standing yet and apparently likely to stand until nature, by its normal processes, brings about decay. On the other hand, if the volcano is the best friend of man and his works, then Nicaragua should be an ideal location for a Canal . But what about St. Pierre and St. Vincent?. To carry the "safety-valve" argument out to its logical conclusion, we shall have to believe that, the nearer one could place the Canal to a chain of volcanoes, the better for its permanence. Yet, we cannot but remember that at the present moment a whole islandful of people are clamoring for escape from a volcano-protected region, while the government of France is seriously considering an order for complete evacuation. While it is probable that the relief afforded by eruptions tends to mitigate the violence of earthquake shock, it must not be forgotten that the enormous outflow of matter from the crater's mouth is frequently accompanied by a serious subsidence of the land in the neighborhood. Now absolute permanence of level is a fundamental requirement for a canal, for it would take but little increase or decrease of elevation to ruin such a waterway beyond chances of repair. The construction and continuous operation of the Panama Railroad are the very best argument for the construction and operation of a canal in the same region. At Nicaragua, on the other hand, there are absolutely no engineering works that can testify by their condition to the absence of seismic disturbances of a fatal character, while we have a terrific object-lesson in the existence of earthquake disturbances in the ruin, a few decades ago, of the city of Rivas, situated five miles from the Pacific terminus of the Nicaragua Canal.

A SCIENTIFIC WITNESS OF PELEE'S ERUPTION.

It is satisfactory to know that Prof. Robert T. Hill, who is at the head of the expedition which was sent to Martinique by the National Geographical Society, succeeded in getting a near view of Mont Pelee just at the time when the last violent explosion occurred. He reached Morne Rouge, the summer resort of St. Pierre, where he obtained a series of valuable photographs. Prof. Hill states that at 7 o'clock on Monday evening he witnessed from a point near St. Pierre, a frightful explosion of Mont Pelee, and was able to take note of the accompanying phenomena. He states that following the salvos of detonations from the mountain, gigantic mushroom-shaped columns of smoke and cinders ascended into the clear, scarlet sky and then spread in a vast black sheet to the south and directly over his head. Through this sheet, which extended to a distance of ten miles from the crater, vivid and awful lightning-like bolts flashed with alarming frequency; they differed from lightning in that they were horizontal and not perpendicular. This Prof. Hill considers to be indisputable evidence of the explosive oxidation of the gases after they left the crater—a most important observation and a phenomenon which is entirely new in volcanic history and goes a long way to explain the awful character of the catastrophe.

SENSIBLE VIEW OF THE STEAMSHIP COMBINE.

We note that the General Director of the North German Lloyd Company, in an interview with the Berlin correspondent of the New Yorker Staats Zeitung, has given it as his opinion that the feeling against the shipping combine which prevails more or less in Germany and England, is altogether unwarranted. In the director's opinion, Mr. Morgan in organizing the combine had no intention of controlling the German lines, and he predicts that before the end of the year events will prove that the union is one of the healthiest developments in the history of transportation, since no party to the contract obtains advantages over others. We believe that this sensible view of the matter will be found to be the correct one. It was only a question of time before the various shipping companies came together in an endeavor to handle transatlantic traffic on some basis of mutual concessions and accommodations. There was much to be gained and nothing to be lost by such a move. As long as the various lines were working independently there was bound to be a considerable amount of wasted energy, a loss which can now be avoided by a schedule of steamer sailings, which will make it possible to carry a maximum number of passengers on more convenient and better distributed days of sailing and for a less cost. This will certainly mean a better service, and may mean a cheaper one; so that while the profits of the shareholders will be increased, the purse of the traveling public may also reap a corresponding advantage in cheaper fares.

THE HOUSE NAVAL BILL.

The important amendment to the Naval Appropriation bill recently adopted by the House calls for the construction of three warships in the government yards, the ships to consist of one battleship, one cruiser and one gun-boat. As the bill previously stood, the question was left to the discretionary power of the Secretary of the Navy; but by the provisions of the bill in its present form, it is obligatory upon him to apportion warship construction to the government yards in the manner indicated above. As we have already stated in these columns, we believe that the measure which has thus passed the House is an eminently wise one, and that it will prove to be not merely a safeguard for the interests of the navy, but a stimulus to the private shipbuilding firms, which will ultimately redound to their own advantage. The apportioning of some of the warships of each year's programme to the government yards cannot deprive the private yards of work which they would otherwise secure, or rather work which they would otherwise perform, for the reason that the yards that are capable of constructing warships are already full of orders, and many of them are considerably behind their contract time on government work. The measure, as we understand it, is not in any sense hostile to private builders; it was conceived and carried through the House with the single object of preserving intact the splendid working staff of our navy yards, and by providing alternative work in the shape of new construction, preventing the annual disruption of that staff which has hitherto taken place whenever repair work became scarce. We are, therefore, of the opinion that the adoption by the House of an amendment which provides that the Secretary of the Navy may build all of the new ships in government yards, if he thinks that there is evidence of combination among private bidders, was unnecessary. So far from there having been any collusion to keep up prices, the indications are that there has been keen rivalry in securing government work of the kind. If prices have been high, it has been largely because of inexperience in work in which severe exactions are required by the government inspectors. The division of naval construction between government and private yards is practised in every country but our own, and the fact that the custom has been followed for many years would indicate that the system works satisfactorily. There is no reason to doubt that it will show just as good results here as abroad.

TUBES VERSUS SHALLOW-TUNNEL RAILROADS.

BY OUR ENGLISH CORRESPONDENT.

Now that the success of underground rapid transit by tubes in London has been established, the British Board of Trade are desirous of extending and developing the system. In order to ascertain the relative advantages and drawbacks of both the deep-level tubes and the shallow tunnels, the Board of Trade dispatched its special railroad inspector, Lieut.-Col. H. A. Yorke, of the Royal Engineers, to Paris, to investigate the construction and working arrangements of the Chemin de Fer Métropolitan, two short branches of which have been completed, totaling 6.6 miles. The railroad has proved a great success, 36,000,000 passengers having traveled upon it during the ten and one-half months it has been opened. These lines are the first cords of a web that is to link all the different suburbs of Paris. When the system is complete, there will be a total length of 38.86 miles of track, of which seven-tenths will be laid in shallow tunnels, and the remainder in open cuttings or on viaducts. The cost of the whole scheme is computed at $60,000,000.

Two classes of travelers are carried. The authorized fares are 5 cents first-class, and 3 cents second-class, whatever the length of the journey. Second-class round-trip tickets are issued at 4 cents up to nine A. M., and the return half is available for the remainder of the day.

According to Lieut.-Col. Yorke's report, which has been issued in a Parliamentary paper, much trouble was caused during the construction of the tunnels by the lines of sewers and water-pipes which were moved from the centers to the sides of the streets. It apparently failed to strike the authorities that these conduits might advantageously be laid along the subways themselves. The tunnels were made as near the surface as possible, and for the most part the tops of the rubble masonry arches, by which they are lined, are about 3 feet 6 inches below the level of the thoroughfare. An attempt was made to accomplish the excavation by means of shields; but ultimately this method, which has obvious disadvantages followed so near the upper crust, was abandoned in favor of the old-fashioned "cut-and-cover" plan.

An interesting feature is that each section of the system will be self-contained, and will end in loops, so that shunting may be obviated. No trains will run from any one distinct section of line into any other, but the systems meet in central stations where a change can conveniently be made. This arrangement has its disadvantages, but on the other hand, it avoids the danger of the whole system being thrown out of working order by a breakdown of any single branch; it does away with junctions and crossings and the attendant need for complicated signaling installations; and it enables a rapid service to be maintained with punctuality and regularity on each section.

Lieut.-Col. Yorke thinks, as the result of his investigations of the Paris system, that as regards convenience of passengers and economy of working, the balance of advantage lies with the shallow tunnel, or subway, as compared with the deep-level tube. But he considers the plan impracticable in busy cities, such as London, owing to the dislocation of the street traffic while the roadways are in process of being undermined. The difficulties in the way of adopting the tunnel system in the principal streets would, he says, be formidable, and he considers them prohibitive. Where, however, new thoroughfares are being made, the obstacles presented to the construction of shallow subways are not so serious, and advantage might well be taken of the opportunities so offered to build subterranean channels for tramways and railway purposes—if not even for ordinary vehicular traffic—in the manner proposed by the London County Council along the new street now being made from the Strand to Holborn.

SOME ACTIVE AND EXTINCT VOLCANOES.

BY CHARLES F. HOLDER.

The terrible holocaust which has devastated the islands of St. Vincent and Martinique takes rank in its appalling significance with the most frightful disasters of history. There was time to escape from Herculaneum and Pompeii, but never so far as known has an entire community been wiped out of existence on the instant in the manner illustrated at the southern islands of Great Britain and France. Anyone who has studied the sun spots and noted the vast outward rushes of fiery gas or material from the surface of the sun, projected thousands of miles into space, can imagine that at St. Pierre something of the kind, on an infinitesimal scale, had happened. The fact that the volcano of Pelée had been "dead" for fifty years shows that there is an element of uncertainty about these splendid monuments to the hidden powers of the earth and suggests that those who insist upon living on the slopes of other "dead" or sleeping volcanoes, as Vesuvius, are acting with open eyes and taking the chance of death.

The United States, or that portion included in the continent proper, is comparatively free from such menaces to human life, yet there are many localities which show that the volcano has been in the past an active factor in the country. In New Mexico the traveler passes a number of old volcano cones, and miles of the country are covered with lava which ran in a fiery flood over the valleys, devastating the land. This is pointed out as the flow of an extinct volcano, and there is no legend or history to tell when it occurred. As a matter of convenience, an extinct volcano is one which has not displayed any activity for one hundred years, but this is no guarantee that it is not liable to reawaken. The people who died at Herculaneum had been taught to believe that Vesuvius was an extinct volcano.

Volumes have been written about volcanoes and their causes, but in point of fact, very little is known about them beyond what we see. In the eighteenth century Humboldt tells us "225 volcanoes erupted," and this is known to be far below the actual number, and doubtless the "extinct" volcano is merely dormant. Etna, which towers 11,000 feet into the air and has a circumference of about 100 miles, has been active periodically for thousands of years—300,000 at least. For the past two thousand years it has had eruptions about four times a century, or every twenty-five years. Etna is a typical periodic volcano; while Stromboli is an example of continued mild eruptions. The photographs of the moon exhibit a remarkable state of ancient volcanic eruption, the face of the moon having the appearance of a pepper box, and doubtless from a great height the earth or certain sections would have a similar appearance, as volcanoes, ancient and modern, are more common than generally supposed. The Pacific Ocean, especially in the equatorial region, is dotted with them. The following groups are conspicuous volcanic centers: the Society group, Marquesas, Navigator, Feejees, Friendly Islands, New Hebrides and Ladrones. Many of these are active, as Tauna and Ambrym in the New Hebrides, Tafoa and Amargura in the Friendly Islands, Tinakora in the Santa Cruz Islands. Mona Loa, 13,760 feet high, is one of the splendid active volcanoes of the world, as well as Mt. Hualalai, 10,000 feet, while Mount Kea also, on the Hawaiian Islands, is now supposed to be extinct. At least ten of the islands, including Martinique, representing the West India group, are volcanic and bear volcanoes. In the Mediterranean country we have Vesuvius, the volcanoes of Sicily and others in Spain, France, Germany, etc., formerly more or less active. Near Greece there are five volcanic islands. Mt. Ararat, 16,950 feet, is an ancient volcano, and along the Red Sea are many volcanic cones. Passing on to Java we find fifty volcanoes, twenty-five of which are active, and the same is true more or less, of Sumatra and Borneo. About the latter over one hundred make life strenuous among the small islands. Madagascar, Mauritius, the Isle of Bourbon, and Comoro Islands, all have volcanoes, and as we approach the South Pole the smoke of Erebus and Terror suggests volcanic activity. Africa is not particularly famous in this respect, but the Bight of Benin and the various islands are volcanic. St. Helena, the Canaries, the Cape Verde, Madeira, Iceland and the Azores are virtual volcanoes more or less ancient.

With the Philippines we have acquired fifteen or twenty volcanoes. Patagonia has its volcanoes; Chili can boast of thirty-two, Aconcagua being 23,000 feet in height, and there are a dozen in Peru and Bolivia. Quito is surrounded by nearly twenty volcanoes, none of which are under 12,000 feet, Cotopaxi (19,660 feet) being the center of interest. Coming up the coast the volcano seeker will find nearly forty in Central America, and in Mexico a number, large and small.

The volcanoes of America, or of the United States, are of especial interest and they are found in the Western country, as a rule west of the Rocky Mountains. One of the most beautiful of these is Mt. Shasta, 14,440 feet high, which rears its massive twin cones in Northern California. Mt. Helena in Oregon, 12,600 feet in height, is a majestic volcanic peak, and Mt. Hood, 11,225 feet, has a world-wide fame for its beauties, little thought being given to its activity in the early geological history of the continent. Other famous peaks are Mt. Jefferson, Mt. Adams, Mt. Rainier, Mt. Baker and Mt. Lassen.

In the Aleutian chain there are twenty-one islands with volcanoes. Kamtchatka has fifteen or twenty, the Kurile Islands thirteen, and the Japan group twenty-four. In a word, the world is fairly dotted with volcanoes more or less notable for their activity in ancient or modern times. The catastrophe of Mt. Pelee calls to mind other famous eruptions. The extinct volcano of Maui, 10,217 feet high, not many centuries ago emitted a river of lava two miles wide. In 1779 Vesuvius tossed cinders 10,000 feet into the air. During the time of Christ Vesuvius was extinct; even its crater was covered with verdure and its slopes to the summit with vines and trees; then Pompeii was destroyed and one thousand years passed in silence until 1036, when an eruption occurred. In 1631 towns about the base were destroyed, and it is known that the outbreaks have increased in volume and violence in time; yet people still live on the slopes, inviting the fate which is almost certain to come in some later generation.

In 1815 Tomboro on the island of Sumbawa erupted, causing a panic in the Javanese group. Herschel estimated that the ashes if collected would have made a solid mass three times the size of Mont Blanc. For days utter darkness hung over the island and explosions were heard in Ceylon, nearly one thousand miles distant. In 1783 Mt. Reykjanes threw out a mass of lava equivalent to twenty-one cubic miles. Perhaps the most remarkable flow was that of Kilauea, one of our own possessions, which in 1840 ejected a river of lava forty miles long; if collected it was estimated that it would have covered a square mile eight hundred feet in depth. The roar of the volcano of Cosequina, Nicaragua, in 1835, was heard at Jamaica, eight hundred miles northeast. That of St. Vincent in 1812 was heard on the llanos of Caracas. The volcano of Souffrière at St. Vincent, now devastating the island, and supposed for years to be extinct, has many times wrecked portions of the island, the eruptions of 1718 and 1812 being particularly terrible. The latter has been remembered as "Black Sunday." The inhabitants of Barbadoes thought that the fleets of France and Germany were engaged, so loud was the continued roar, yet Barbadoes is eighty miles distant. This island was buried deep in gloom from the dust of St. Vincent and covered several inches deep, yet the St. Vincent islanders forgot the warning, and on the termination of the present outbreaks on this island and Martinique the places not covered with lava will again be occupied, St. Pierre will be restored and life, or what there is left, will move on until the next cataclysm.

VALUABLE MINERALS.

BY GEORGE E. WALSH.

The output of the mineral products of the United States in 1900 showed a large increase over that of any previous year, and with a grand total of $1,070,108,899, according to the Geological Survey Report, we are one of the most important countries in the world both as to mineral resources and to the variety obtained. The increase in precious metals and stones was most noticeable because of the discovery of new fields for operation. While never recognized as a country rich in diamonds and other precious stones, the United States has yielded some precious stones of considerable value, and with the extension of our mining industry for ores there is gradually brought to light more of these products.

The output of so-called precious stones in 1900 was valued at $233,170, but this does not include garnets used for abrasive purposes, nor many others employed in the arts and industries. The total value of gems of quartz origin is considerable in this country, and the mining of these has almost become an industry by itself. Rock crystal is now employed to a much larger extent than ever before for imitating diamonds and other precious stones, and also for producing desirable effects in decoration and refraction of lights. Rock crystal is really the purest form of quartz, and it is found in this country so transparent and colorless that it becomes one of the most useful of our semi-precious minerals.

One of the finest rock crystals in the world was found in 1876, and was cut into a magnificent crystal ball for the late Gov. Ames, of Massachusetts; it is now in possession of the Boston Fine Arts Museum. The ball measures 7¼ inches, but the original crystal from which it was cut was some 18 inches high and 12 inches thick. But this crystal was not found in this country, although a 5-inch crystal ball found in Ashe County, North Carolina, and another near the summit of Mount Antero, Colorado, were nearly as handsome as the one in the Boston Museum. The former is cut in a ball 5 inches in diameter, and the latter 6 inches.

There are a number of well-defined regions in this country where rock crystals are found, and mining for them is carried on with more or less regularity most of the time. But the most remarkable ones have been found by chance rather than by any definite clew to their whereabouts. One of the well-defined regions where quartz crystals have been found in the past dozen years is at Hot Springs, Colorado, on the banks of the Ouachita. A remarkable feature about these stones is that they are so worn by the tide and current that they are round like pebbles. In most cases they are very clear crystals, and they are of fair value. Some have been cut and sold for good prices. They are not different, however, from the quartz crystals found on the Atlantic coast at various points, although of a rather purer and higher grade. Transparent quartz pebbles are frequently sold in cities under the name of imitation diamonds. They can be cut and polished to a rich brilliancy, so that they attract nearly as much attention as the genuine stones, but they soon lose their luster and cannot be retouched again without recutting.

The various colored quartz crystals produce many fine specimens of stones which are used in the jewelry trade. Thus the amethyst is a transparent purple variety of quartz. Some varieties are so plentiful that they have lost much of their ancient value. The finest deep purple gems naturally command nearly as much attention as ever, and when cut properly they sell for good prices. Small but very fine amethysts are now found in parts of Pennsylvania, Maine and North Carolina. These stones are eagerly sought after, and occasionally a large one is found which is valued nearly as much as those imported from the Orient.

Agates and chalcedonies have also in recent years been mined in considerable quantities and variety in this country, and their value is proportioned somewhat to the quality of their grain. The best agates are found in hard nodules where the rocks have disintegrated through one cause or another, and consequently they are strewn in places along the coasts and beds of streams. Agate pebbles, which present rather a fine appearance and readily lend themselves to cutting for jewelry effects, are found in considerable quantities on the California beaches, especially at Pescardo. These pebbles are often neglected by visitors because of their rough external appearance, but when cut and polished they have fine coloring and grain. They are now used in a dozen different ways for ornamenting trinkets, match boxes, beads, studs and handles of knives and forks. In recent years the best agates and chalcedonies have advanced in price, and efforts have been made to imitate them. Deep-red carnelians and sards are produced in this way by skillfully burning the pale or dull chalcedonies. Black agate is made in the same way, and is very popular for mourning jewelry. In Wyoming large masses of moss agates have been found, and when cut properly they are very pretty. These are used for table tops and other ornaments.

The treatment of chalcedony by chemical and other processes has greatly widened the uses of this mineral. By treating it in different ways it is possible to make the coloring suit almost any passing fashion. The so-called "golden opal" is made by boiling chalcedony in honey and then in a solution of chromate of lead, and finally placing it in hydrochloric acid kept at a moderate heat for a few weeks. Other colors and stripes are obtained by boiling the mineral in such solutions as blood and water, sugar and water, and molasses and water, and after it has absorbed these boiling it in sulphuric acid.

In fact, modern chemistry has produced such changes in the colorings of many of our stones and minerals that it is possible to imitate many of them and improve upon nearly all. Any colored onyx can be obtained by simple chemical processes, and the common dull colors of this stone can be converted into brilliant hues, thus greatly increasing the value. Not only can the whole stone be made to change its color, but sections and lines of it can be made to assume a red, black, yellow or white color while the rest is pure white or black. Agates are easily converted into an onyx-like substance and character, which lapidaries use for cameos and intaglios. Altogether, our chemical treatment of some of the abundant stones and minerals has not only widened and developed the resources of the country, but it has made it possible for the poor to possess good imitations of jewels which at one time were considered almost priceless.

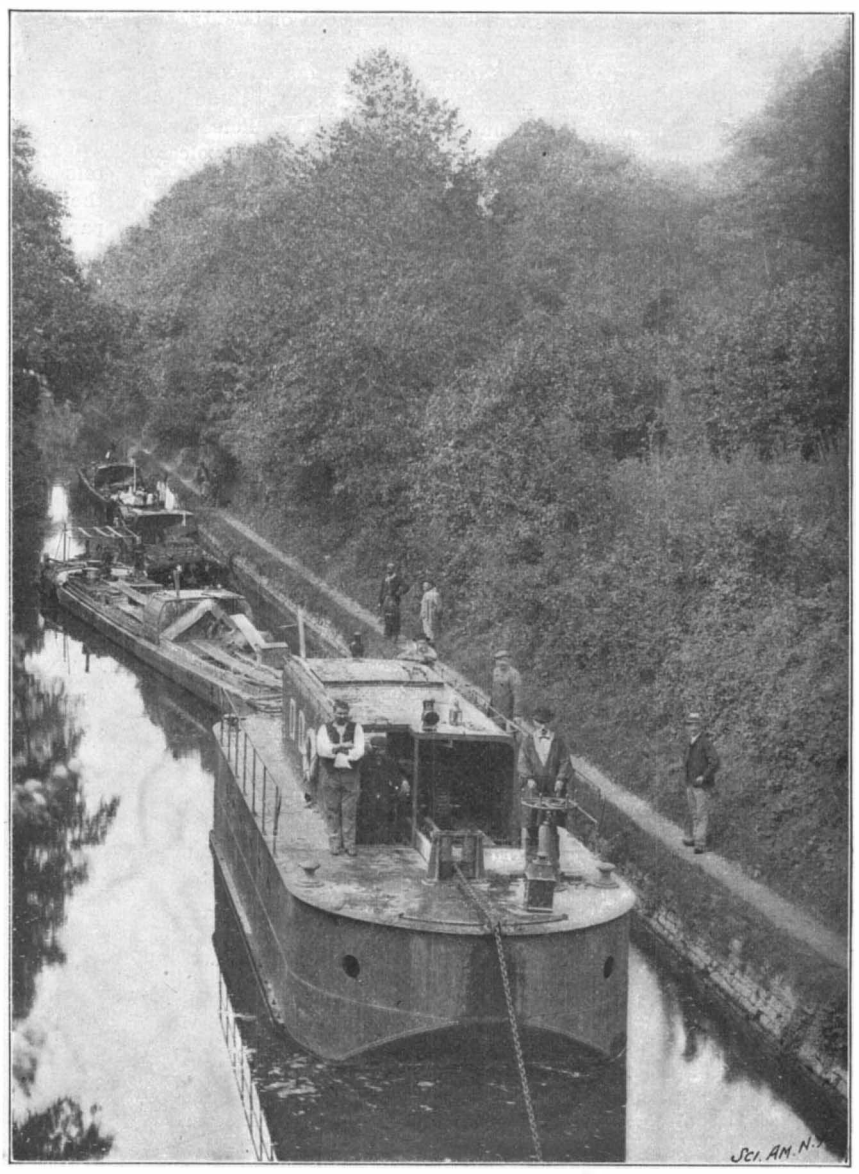
Captain Lawrence, who was recently in command of the Signal Corps of the First Brigade at San Francisco, Cal., has invented a safety shield and signal for the protection of the markers stationed behind the targets at rifle contests. The markers are stationed in a bullet-proof house at the side of the target where there can be no possibility of injury, but if they should leave this shelter for any purpose whatever, a signal is automatically shown over the face of the target. The signal is operated electrically by the movement of the door of the shelter.

TRACTOR-BARGES ON THE NIVERNAIS CANAL.

In the very heart of France, extending over 111 miles between the Loire and the Yonne, one of the Seine's tributaries, is the picturesque Nivernais Canal. The summit level of the canal is to be found between the Baye and Port Brûlé, 28 miles as the bird flies, north of the junction of the canal with the Loire. Such is the peculiar section of the canal, and so insufficient is the width of the towpath at its summit, that it has been impossible to utilize the customary tow horses, and it was therefore necessary to resort to towing by men. Since the canal at its summit lies partly in tunnel and partly in a deep cutting, it could not manifestly be readily widened. The plan was hence adopted of employing mechanically-driven barges. Through the courtesy of M. Mazoyer, of Nevers, the engineer of the canal, we are enabled to present illustrations and full particulars of this interesting experiment.

Mechanical haulage is accomplished by means of an immersed chain. The chain was laid last August, in which month the towboat was tested in actual service. The engine with which the boat is equipped is a four-cycle petroleum Foret motor of sufficient power to enable the boat to tow three barges over the 2½ miles of the summit level in one hour and four minutes.

Every day the boat makes two journeys each way. For these four trips the consumption of fuel varies between 5 and 6 gallons, or about 10½ pints per barge hauled. At the rate of 41 centimes per liter the cost of fuel per barge hauled over the 2½ miles is about 2 francs and 46 centimes. Empty boats are towed free of charge.



TRACTOR CANAL-BOAT ON THE NIVERNAIS CANAL.

A National Physical Laboratory of Great Britain.

A national physical laboratory has been established in Great Britain which will prove of inestimable benefit to the various industries of the country. The scope of the institution is similar to that of the Imperial Physical Technical Institute of Berlin, which has enabled the Germans to absorb more than trade, such as the manufacture of scientific instruments, optical glass, aniline dyes, etc., which a few years ago were regarded as English monopolies.

The necessity of such an institution has been felt in Great Britain for many years past. It was Dr. Oliver Lodge, the eminent electrician and scientist, who first suggested the idea, and in 1896 Sir Douglas Galton made it the principal subject of his presidential address to the British Association. The result of Sir Douglas Galton's efforts was that a Parliamentary committee was formed five years ago to investigate and to ascertain the advisability of founding such a laboratory. At first it was contemplated to inaugurate the undertaking at Kew in connection with the observatory there, but after careful consideration it was decided that such a step might interfere with the work of the observatory, so it was resolved to establish the institution at Bushy House, Teddington. The government supported the scheme by a grant of $100,000, and several manufacturers throughout the country extended financial assistance. The late Queen Victoria presented Bushy House, a former royal residence, to the society for conversion into workshops and laboratories.

The work of the institution will exercise a great influence upon the scientific and industrial prosperity of the country. The work will be divided into two principal ramifications—physics and engineering. There will also be an observatory department, which will be carried on at Kew Observatory as heretofore. One of the first and most important aims of the institution will be the foundation of accurate standards. This has long been regarded as absolutely imperative by British manufacturers in view of the success of the system in this country, but the object has never been accomplished owing to the absence of a central agency by which it might be carried out.

The work of the British Alloys Research Committee, commenced by the Institution of Mechanical Engineers, will be continued by the society. This work is of the greatest assistance to those manufacturers who use iron and steel under varying conditions. It affords them an exact standard for combining iron with various alloys, and for heating in the most effectual way to get the best results. Another important research will be in connection with the foundation of a wind pressure standard for bridges. At present the Board of Trade, which is responsible for the safety of such structures, insists upon a maximum wind pressure of 56 pounds per square foot. The determination of the wind pressure is a difficult and intricate process, and an ideal wind gage can only be obtained after the expenditure of considerable engineering skill, patience and time. But it is generally conceded that the Board of Trade maximum pressure of 56 pounds per square foot is excessive, the result of which is that unnecessary expense is incurred in the erection of such structures. The laboratory, therefore, intends to discover the exact wind pressure required in a bridge to insure safety.

A GENERAL VIEW OF THE TRACTOR CANAL-BOAT.

The testing of steam gages for boilers will be another important feature of the institution. Electrical and mechanical instruments, thermometers, metals, lenses, etc., will be tested, and the standardization of weights and measures of a kind necessary for laboratory purposes will be carried out. The main object of the tests will be the improvement of materials, and for this purpose the highest standard will be established as the ideal.

The Institute of Naval Architects has decided to erect, equip and maintain a testing tank after the design of the late M. Froude, and similar to that in use at the navy yard at Washington, for the determination of data relating to vessels. At the present moment there is only one shipyard in the world, outside of the naval departments of various nations, which possesses a testing tank, replete with every modern appliance. This is Messrs. Denny & Co., the eminent firm on the Clyde, Scotland, and this firm has found such an acquisition invaluable in connection with its shipbuilding work.

The laboratory will be under the directorship of Mr. R. T. Glazebrook, former principal of the University College, Liverpool, with an experienced staff of assistants. The maintenance of the institution will be largely dependent upon manufacturers, although the government is extending its support. Salaries will alone represent an item of $20,000 per annum, which sum will increase as the work of the laboratory develops.

Nature Study.

Prof. Bailey, of Cornell University, gives a weighty answer to the question: "What is nature study?" It is, he says, a point of view, the acquirement of sympathy with and interest in the natural world around us. We live in this world, and the better we fit it the better for us. It is for this reason that nature study deserves a place in the school studies of children. Primarily, the object of nature study is not the acquisition of mere information. Nature study is not "method" in the sense that the word is used in pedagogy. In another sense scientific method is of the very essence of nature study, it would seem. A child asks: "How old is the world? How long have men lived on it? Why has a tiger stripes? Why do certain flowers have exactly such shapes and no others?" To answer these questions the child must be made to comprehend the methods at the base of geology, zoology, botany. And in this sense it would seem that method is of the very essence of nature study.

The object of such studies is not to make the child a specialist or a scientist. It is to make him a citizen of the world he lives in—to interest him in plants and birds and insects and running brooks. The crop of scientists will take care of itself. Much is often unwisely sacrificed to a so-called "thoroughness"—which, in many cases takes the form of a perfunctory drill in mere acts. Accuracy is, of course, a prime requisite of all good teaching, but it is necessary, first of all, to awaken genuine interest. The first essential is direct, discriminating, accurate observation. The next is to understand why, and the third is the desire to know more. The final result should be the development of a keen personal interest in every natural object and phenomenon.

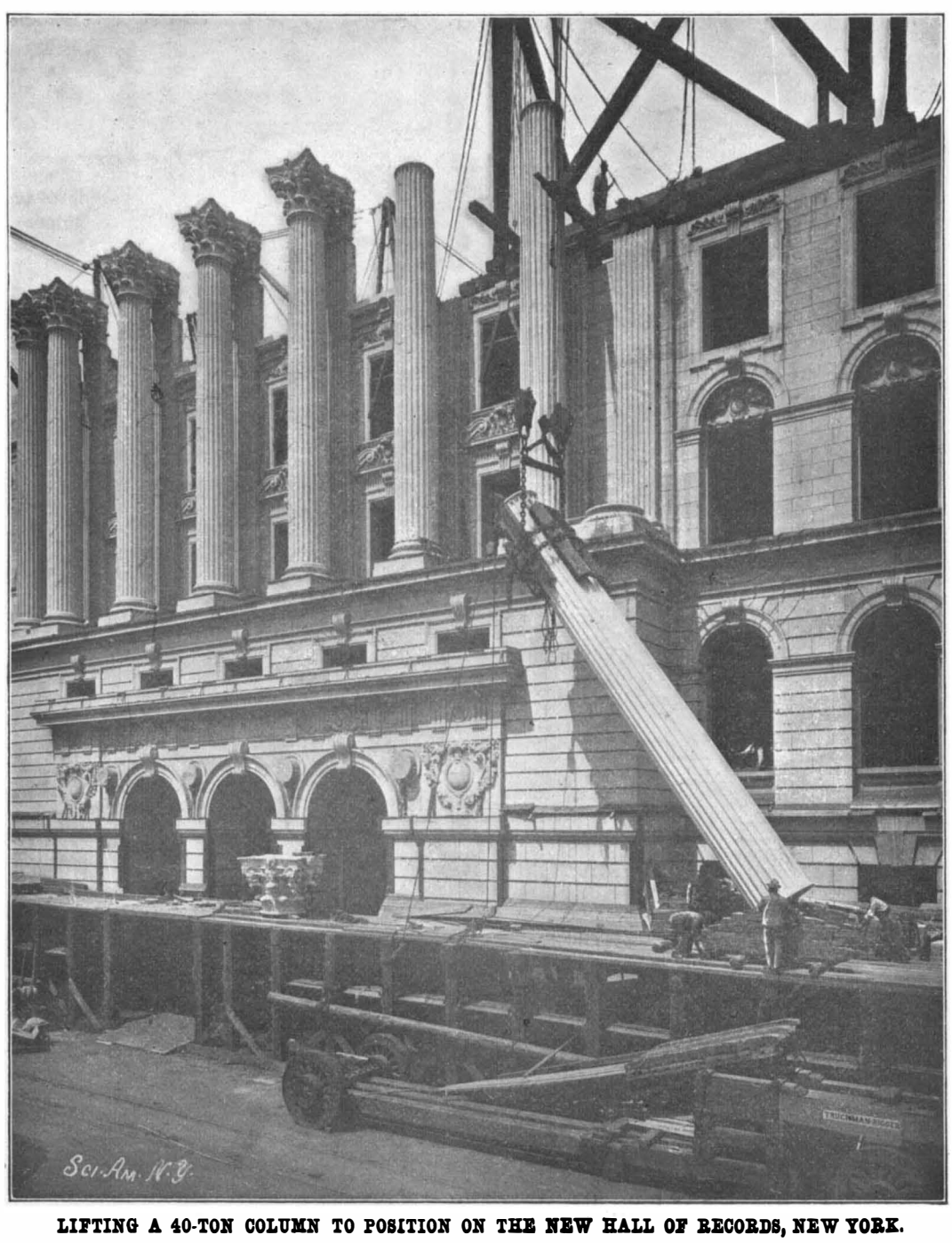
A new railroad bridge which is to be constructed over the river Tyne at Newcastle, England, will be the largest bridge-building undertaking in the United Kingdom since the completion of the famous Forth Bridge. The work has been designed by Mr. Clark R. Harrison, the chief engineer of the North-Eastern Railroad Company, and its cost will approximate $2,350,000. The new bridge will carry three lines of railroad, there being a length of over half a mile of viaduct. There will be three large spans of steelwork, the abutments and masonry supporting which will be of gray granite. The foundations of the piers will be constructed by the aid of large cofferdams and steel caissons. The rail level above high water will be 110 feet. There will be some 8,000 tons of steel used in the structure. The work, it is computed, will occupy two years to complete.

SETTING THE HEAVY GRANITE COLUMNS ON THE HALL OF RECORDS.

The handsome Hall of Records which is now building at the corner of Chambers and Center Streets is beginning to take on material form and to show forth the beauty of its design. Eight of the huge columns which are to adorn its exterior have been delivered and set up in position on the front of the building. The columns are the largest monoliths so far used in this city, having a shaft 4 feet 2 inches in diameter, and 36 feet long. The capitals are 6 feet in height and the base-stones 2 feet thick. The weight of each shaft is estimated at between 38 and 40 tons. The base-stones weigh 6 tons, and the capitals, carved from 19-ton blocks of granite, are estimated as weighing 15 tons. The columns were quarried from a white granite called Hallowell granite from Hallowell, Me. This stone, due to the homogeneity of its grain can be easily carved. It does not, however, take a good polish, and is ordinarily, as in this case, finished in the rough. One of the greatest difficulties in quarrying large blocks of stone is to find a suitable platform of stone free from cracks or flaws. Granite is a stratified rock, and whenever a large flawless layer of sufficient thickness is discovered, it is carefully reserved for use in filling large orders. When such an order comes the edge of the granite layer is faced and the required block is broken away by a moderate charge of powder placed in holes at frequent intervals along the desired line of fracture. The stones are then cut by hand to the proper shape, patterns being continually used to insure a perfect form. It took six to eight weeks to shape and flute each of the shafts shown in our illustration. When completed they were carefully boxed and sent by rail to Mott Haven, whence they were lightered to Pier A, at the Battery. From this point the truck shown in our illustration was used for carting each column to the building. The hauling was done at night when lower Broadway was practically deserted. In order to prevent the trucks from sinking into the asphalt street at the pier, planks were placed under the wheels and then the huge stone was lifted by a powerful derrick and lowered gently onto the truck. Twenty-two horses were used in carting the shafts to their destination, and in passing up Broadway depressions were constantly made in the street and man-holes were cracked and broken.

The problem of setting the columns was no small one. The derricks available had each a lifting power of 25 tons, and it was necessary to use two at a time to raise each column. It was important that each derrick should bear an equal part of the burden, for should a greater weight than 25 tons be accidentally shifted onto one of the derricks, a catastrophe would result. In order to preserve an exact balance of weight, a single stretch of cable was used for both derricks, the cable passing around an equalizer block which may be seen in the engraving between the two four-sheave blocks. Special care had to be exercised to protect the fluting from injury while the shaft was raised. Half round birchwood sticks, spaced and sized to fit snugly into the channels, were nailed to oak blocks, and the chains were then wrapped over these blocks around the shaft. Lewises were anchored in dovetail openings in the top face of the shaft and to these a block was lashed which abutted the ends of two of the side blocks. The purpose of this was to prevent the birch sticks from sliding along the fluting and breaking the stone at the end of the channels. Another difficulty which presented itself was the danger of damaging the butt of the shaft if it were permitted to bear the weight of the stone while being raised to vertical position. This difficulty was overcome by building a cradle, as illustrated, and resting the column on a round stud extending between the side walls. Two 3-inch steel pins inserted in the base of the shaft straddled this stud to keep the stone from slipping. The cradle was mounted on rollers and was so connected to the top of the column that any upward movement of the latter would result in a forward movement of the cradle. This advance motion was assisted by the use of hand-spikes as the shaft approached the vertical. The purpose of this device was to prevent sidewise swing of the derrick boom and to assist in the rapid setting of the columns. Twenty-four more columns are to be placed on this building, making thirty-two in all. The dimensions of these columns are the same as those just described, except that instead of having a round cross section, they are cut away along the rear surface where they will come in contact with the building.

THE END OF SEVERO'S AIRSHIP.



LIFTING A 40-TON COLUMN TO POSITION ON THE NEW HALL OF RECORDS, NEW YORK.

THE SEVERO AIRSHIP CATASTROPHE.

BY OUR PARIS CORRESPONDENT.

One of the most terrible accidents in the history of aeronautics is that which recently occurred at Paris, resulting in the death of the Brazilian inventor Severo and his aid, M. Saché. It was on the 12th of May that the dirigible balloon "Pax" made a free ascension for the first time from the Lachambre Aerostatic Park in the western part of Paris. The airship mounted at 5:40 A. M. A few minutes after the departure, when the balloon had risen to a height of 1,000 feet over the city and half a mile from the shed, a formidable explosion occurred, followed by a rapid fall of the airship, which was smashed to pieces on the Avenue du Maine. The two aeronauts were instantly killed.

The balloon "Pax," which has been recently described, was constructed at the Lachambre establishment, where the different balloons of Santos-Dumont were built. It was kept in an immense shed 100 feet high which had been built especially for it. It will be remembered that the form of the balloon is cigar-shaped, somewhat resembling that of Santos-Dumont's, except that the car, instead of being suspended below the body by cords, is partly surrounded by the balloon, the upper part being contained in a longitudinal groove which ran the whole length of the balloon body. It is also much larger and contained 80,000 cubic feet of gas. It was inflated with pure hydrogen, generated on the spot. The balloon had been filled for several days previously and had made a few trials in the adjacent grounds, and M. Severo was only waiting until the prevailing bad weather had ceased in order to make an ascension. On the preceding evening the weather cleared, and at midnight the preparations were commenced for a trial the next day. The workmen gave a final filling to the balloon and the operation finished at dawn, when the airship was taken outside.

Except for a light mist, the sky was clear, and a feeble west wind was blowing. Some preliminary trials were made near the ground, and the balloon seemed to make its evolutions with perfect ease, as it turned twice to the right and twice to the left and appeared to be easily handled. This encouraged M. Severo to make an ascent at once. It was his intention to steer against the wind and gain the maneuvering grounds at Issy, outside the city toward the west. As soon as it was let go the balloon mounted rapidly to a height of 1,000 feet, and then was

observed to follow the direction of the wind and proceed toward the center of the city. Some affirm that the propelling screw worked well, and others that its action was ineffective. The airship was seen to describe several great circles in the air, under the action of the lateral screws, but afterward went in a straight direction. The aeronauts had thrown out too much ballast, which caused the balloon to mount to a great height. This is no doubt the main cause of the catastrophe. About fifteen minutes after the start a flame was seen to shoot out from the balloon, followed by a white smoke; then came a loud detonation, and the airship was enveloped in flames and burned rapidly. The framework shot down with one end foremost. The great mass fell across the Avenue du Maine, the rear screw breaking in the roof of a small house. The rear part, occupied by M. Severo, fell first. The spectators affirmed that the aeronaut was still alive when he reached the ground; his body was terribly mangled and he expired almost instantly. His aid, M. Saché, who was at the other end of the car, met his death in the air, and his body was half burned. After the bodies had been removed the government aeronauts, Col. Krebs and Commandant Renard, with a squad of 17 men, were occupied in clearing away the debris. The engraving gives an idea of the appearance of the wreck as it lay across the avenue, presenting an inextricable mass of broken poles, steel shafting and wires bent and entangled, and the half-burned remains of the envelope.

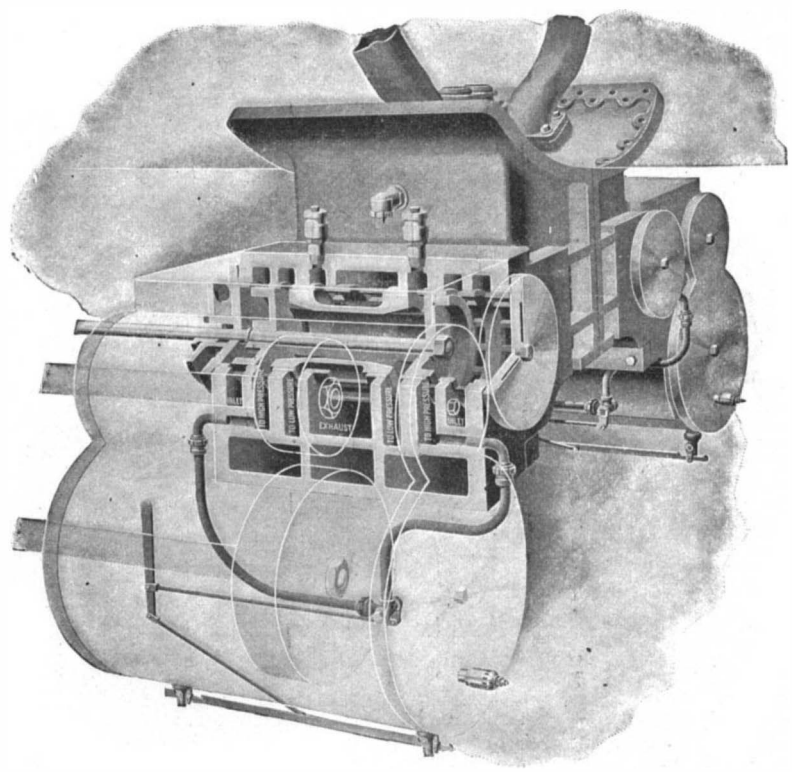
There is a diversity of opinion as to the exact cause of the catastrophe, but all are in accord that the main reasons lie in the balloon's rising too high, with a consequent dilatation of the envelope and escape of gas, and in the proximity of the great inflammable mass of the balloon to the motors and rapidly revolving shafting. It is not certain whence came the flame that ignited the hydrogen. The motor, which is badly burned, may have inflamed the gas or may itself have been burned by the flaming mass. The igniter is almost melted and the carbureter is considerably wrecked, also the gasoline reservoir, which contained seven gallons. There may have been an explosion of gasoline, but this could have been produced either before that of the hydrogen or after the latter had been inflamed. The exhaust pipe of the motor, which must have been brought to a red heat, could have been heated by the gasoline or by the burning hydrogen. Some think that the hydrogen was ignited by the friction of the shafts or gears, which were numerous and ran very near the envelope in some places. The different inflammable materials burned so quickly that it is not easy to say which took fire first. The reason of the escape of the hydrogen is clear. Most of the aeronauts are in accord that M. Severo mounted too quickly. The balloon, which had just been filled with hydrogen in a cool place, soon became very much dilated on reaching such a height. The rays of the morning sun and the difference of atmospheric pressure caused by the elevation to 1,000 feet soon brought about a strong expansion of the hydrogen. The gas may have passed through the silk envelope by rapid endosmose, or its force might have been strong enough to burst the latter; or it may have forced one of the valves which hung at the end of a canvas tube just above the motor. There is no doubt that at the time of the explosion the car was in an atmosphere of inflammable gas, which was all the more dangerous in that it gave no odor to reveal its presence. The large central groove running along the balloon, and containing the upper end of the frame, formed a kind of pocket in which an explosive mixture of gas and air could collect. This would explain the almost complete and immediate destruction of the envelope of 80,000 cubic feet, which came down in a rain of carbonized débris all over the neighborhood.

Santos-Dumont, who is now in Paris, thinks that two explosions of the envelope were produced; the gas burst the envelope by its excess of pressure, and this was immediately followed by the explosion of the hydrogen, which came in contact with the motor. The aeronaut, lacking experience, threw out too much ballast, and the airship mounted very quickly and much higher than was necessary. The fluid dilated, and not finding a sufficient issue, burst the envelope. It will be remembered that the fall was preceded by a detonation, and to form a detonating mixture twelve parts of air are needed for one of gas. The balloon could not, therefore, have contained the explosive mixture at first, or it would not have risen. Santos-Dumont considers, therefore, that the motor was not the primary cause of the explosion. M. Girardot in a conversation with the inventor made several observations on the arrangement of the motor, and both he and Charron insisted that it be provided with escape boxes so that the exhaust gases would not pass out in free air.

M. Severo was born at Rio Grande do Norte in 1864, and his family is one of the wealthiest and most influential in Brazil. After passing his University studies, he devoted himself almost entirely to aerial navigation, as his ample fortune permitted. Besides, he occupied an important position in Brazil, having been elected deputy in 1893 and continuing in the Parliament up to the present. He commenced his experiments about ten years ago, and had some success with his first airship, the "Bartholomeu de Gusmao." The government desired him to build a second airship, and after the success of Santos-Dumont he again took up the matter. The mechanic Saché was one of the most intelligent and skilled employés of the Buchet motor firm, who detailed him to work with M. Severo. The present accident resembles that which took place a few years ago in Germany, resulting in the death of Dr. Woelfert and his aid Knabe. The airship was cigar-shaped and had an explosion motor.

BUILDING OF AMERICAN LOCOMOTIVES.--I.

It would be difficult to find a form of mechanical construction in America which bears more strongly the imprint of our national characteristics than the American locomotive. In its general appearance, constructive details, and unquestionable convenience of operation, it stands entirely distinct as a type among the hundred-and-one styles of locomotives that are manufactured in the shops of the world. This national individuality is seen even more strongly in the great industrial establishments in which our locomotives are made, where labor-saving machinery and carefully-thought-out methods of shop management have enabled us to build at a speed and price which cannot be approached by any other nation. The magnitude of the locomotive industry in this country was emphasized in the festivities which attended the recent completion of their 20,000th locomotive by one of the locomotive works of this country, an event which occurred in the spring of the present year. The early founding of the Baldwin Locomotive Works, its rapid growth, the many standard types of locomotives which have been originated in the shops of the company, and the fact that its locomotives have been for years finding their way to the four corners of the earth render the works thoroughly representative of the locomotive industry in this country.



VIEW SHOWING SECTION THROUGH STEAM CHEST AND GENERAL ARRANGEMENT OF THE FOUR CYLINDERS.

Mathias W. Baldwin, who founded the establishment, started in business as a jeweler in a small shop in Philadelphia in the year 1819. In 1830 the steam railroad was beginning to make its appearance and establishing itself in this country, and to gratify public interest the proprietor of a Philadelphia museum gave an order to Baldwin for the construction of a miniature locomotive for exhibition. In the spring of 1831 the work was completed and the toy was set in motion on a circular railroad track at the museum. The success of the model brought an order to Baldwin for a locomotive from the Philadelphia, Germantown & Norristown Railroad Company. Guided by his experience with the little model, and by some memoranda which he had taken of a locomotive recently imported from England by the Camden & Amboy Railroad Company, Baldwin completed the curious and historical locomotive known as "Old Ironsides," of which we give an illustration on our front page. The engine was tried November 23, 1832, and did duty on the Germantown road and, later, on other roads for a period of over twenty years. The "Ironsides" was a four-wheeled engine, modeled after the English pattern of those days, and it weighed in running order something over five tons. The cylinders were placed beneath the smokebox and connected to a pair of cranks on the rear axle, which was placed in front of the firebox. The driving wheels were 54 inches in diameter, and the front wheels 45 inches in diameter. The cylinders were 9½ inches in diameter by 18 inches stroke, and they were carried beneath the smokebox, as is done to-day with modern inside-connected engines. The wheels had cast-iron hubs, wooden spokes and rims, and wrought-iron tires. The frame was of wood. The boiler was 30 inches in diameter and contained seventy-two copper flues 1½ inches in diameter. The valve motion was given by a single loose eccentric to each cylinder, and the engine was reversed by changing the position of the eccentric on the axle by a lever operated from the firebox. The contract price was $3,000.

The second engine, built in 1834 for the Charleston & Hamburg Railroad Company, was a six-wheeled engine with a single pair of drivers, 4½ feet in diameter, carried behind the firebox, with a half-crank axle of Baldwin's design. The wood and iron wheels used on the "Ironsides" having proved faulty, the driving wheels in this case were cast in solid bell metal. The "Miller" had cylinders 10 inches in diameter by 16 inches stroke, and weighed in working order about 8 tons. The boiler was constructed with a high circular dome over the firebox, a form of construction which was consistently followed for many years afterward. The next engine, the "Lancaster," built in 1834, weighed about 8½ tons, and in that year five locomotives were completed. In the following year, the business having outgrown the works, a location was found on Broad and Hamilton Streets, the site of the present works, then in the suburbs of the city. From that time on the growth of the plant was rapid, fourteen engines being built in 1835 and forty in 1836. Without attempting to go into the details of the progress of the works, it is sufficient to state that several standard American types had their origin in the Baldwin shops, and of these, perhaps the most notable are the "Consolidation," the "Mogul" and the "Atlantic" types. The "Consolidation," from which the type of this name was named, was built in July, 1866, for the Lehigh Valley Railway. She was a remarkably powerful engine for that day, with cylinders 20 by 24; four pairs of drivers connected, and a Bissell pony truck equalized with the front drivers. The engine in working order weighed 90,000 pounds. The "Mogul" class took its rise from an engine built for the Louisville & Nashville Railroad in 1861. The "Mogul" had three pairs of drivers connected, and a swinging pony truck, which was later equalized with the forward drivers. The first "Atlantic" type of locomotive was built in 1895 for the Atlantic Coast Line, which was followed by engines of the same type for the Atlantic City trains of the Philadelphia & Reading Railroad. The 1,000th locomotive was built in 1861. The 5,000th locomotive, built in 1880, was designed for fast passenger service between Philadelphia and New York, and to run with a light train at a speed of 60 miles per hour; its cylinders were 18 by 24, and it was carried on a four-wheel truck, one pair of 6½-foot driving wheels, and a pair of 45-inch trailing wheels equalized with the drivers. The 10,000th locomotive was completed in 1889; the 15,000th in 1896; and the 20,000th in 1902.

A banner year in the history of these works was the season of 1889, when the first of the now celebrated compound locomotives was completed and placed on the Baltimore & Ohio Railroad. It was of the four-cylinder type designed by S. M. Vauclain, the general superintendent, a high and a low-pressure cylinder being carried on either side of the smokebox, the high-pressure above and the low-pressure below, although in some later engines the positions are, for convenience, reversed. The two pistons on either side are connected to a common crosshead, and each pair of cylinders is cast in one piece with the piston, steam-chest and one-half of the saddle. The arrangement is shown very clearly in the accompanying perspective view of the cylinders. The valve, which is double and hollow, controls the steam admission and exhaust of both cylinders. The exhaust steam on the high-pressure cylinder becomes the supply steam for the low-pressure cylinder; and as the steam for the high-pressure cylinder enters the steam-chest at both ends the valve is in practically perfect balance. A by-pass valve is provided to admit live steam to the low-pressure cylinder in starting.

In view of the fact that there is, even to-day, a rather widespread, although mistaken, idea among railroad men that the superiority of the compound to the single-expansion locomotive is doubtful, it is well to draw attention here to two facts: First, that the scientific tests which have been made in experimental engineering laboratories, such as those at Purdue

University and Columbia University, have shown that the compound locomotive is decidedly more economical than the single-expansion; and, second, that where the management, engineers and firemen of a railroad have taken hold of the compound with the determination to give it a perfectly fair trial, it has not proved more costly in repairs and has maintained what we might call its laboratorial reputation for economy. We quote from a paper on the performance of a four-cylinder Baldwin, compound locomotive, by Richard A. Smart, Assistant Professor of Experimental Engineering at Purdue University, in which he draws the following conclusions: First, that there was with an increase of speed an increase of horse power and economy up to 270 revolutions per minute; second, the indications were that the power would increase for speeds considerably above 270 revolutions per minute; third, the increase in economy with increase of speed was chiefly due to a decrease of cylinder condensation; fourth, the average steam consumption of the compound was much lower than the lowest consumption shown by the single-expansion engine; fifth, the saving in steam shown by the compound locomotive would result in a saving in coal of from 18 per cent to 33 per cent.

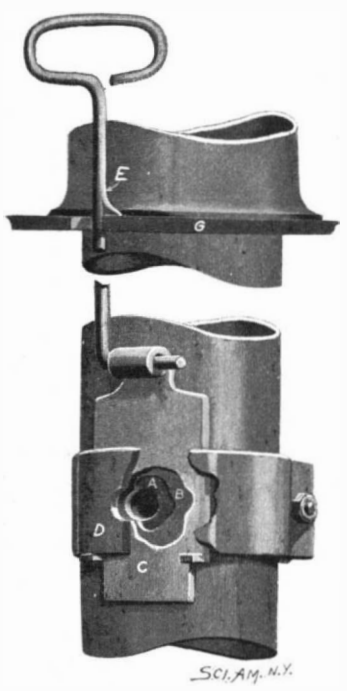
Perhaps the most celebrated locomotives turned out by these works are those which have been built to haul the extremely fast trains which are running between Camden, across the Delaware River from Philadelphia, and Atlantic City. These are of the celebrated "Atlantic" type in which the cylinders drive the rear pair of four-coupled drivers and the weight of the firebox is carried by a pair of trailers. Engine 1027 was built under guarantee to haul a train of eight cars (four coaches and four Pullmans) to Atlantic City, a distance of 55.5 miles, in sixty minutes; or to haul six cars over the same distance in fifty minutes, with a development of an estimated horse power of 1,400. In practice, however, this locomotive exceeded the guarantee by about 10 per cent. Another of the "Atlantic" type was built for the Chicago, Milwaukee & St. Paul Railroad, under contract to haul nine cars between Milwaukee and Chicago in one hour and forty-five minutes, with an estimated development of maximum horse power of 1,600. One of the latter engines exceeded the guarantee by four cars, hauling thirteen cars in the specified time, the train and locomotive together weighing 600 tons. Following on these excellent results the company proceeded to make accurate tests of 1027 to determine just what the locomotive was capable of. It was found that with an experimental train of twelve coaches the horse power increased directly with the speed until it reached 1,450 horse power at 70 miles an hour, and even at this speed the locomotive had a reserve of power to overcome grade resistance or to enable it to accelerate the train to a higher speed.

It is a well-known fact that at the higher speeds the single-expansion locomotive is subject to drawbacks in the shape of wire drawing of the steam, back pressure in the cylinders and overforcing of the fire, which are absent in the compound with its wider range of expansion and its milder exhaust. Careful tests have shown over and over again that there is about 25 per cent economy in a compound as compared with a single-expansion locomotive doing the same work. This is due to the less evaporation required to develop the necessary energy, together with the slower rate of combustion of fuel resulting from exhausting the steam at lower tension. Of course, it is understood that these results are only obtained, as we have before remarked, where the management and operatives of the road are in thorough sympathy with the compound, and are desirous of giving it every facility to show its best results.

The 20,000th locomotive, of which we present an illustration, is a further improvement in which it is sought to secure a more perfect balance of the reciprocating parts than is possible on the ordinary type. The high and low-pressure cylinders, instead of being arranged above one another in a vertical plane, are all carried in one horizontal plane, the high-pressure cylinders within the frames beneath the smokebox and the low-pressure cylinders on the outside of the frames. The low-pressure crossheads are connected with the main driving wheels by outside connecting rods as in ordinary practice. The main driving axle has two cranks, which are set at right angles to each other on each side of the center of the locomotive, and each crank is coupled to the crosshead of one of the high-pressure pistons. The crank on the axle and the crank-pin in the wheel for the corresponding high and low-pressure cylinders are set at an angle of 180 degrees, and the two axle cranks being set at 90 degrees results in the action of each high and low-pressure cylinder on one side of the locomotive quartering with the equivalent cylinders on the opposite side. As a consequence, an almost perfectly balanced engine is secured, and the amount of counterbalance required is reduced to a very low limit. The arrangement is the same as was used by Strong in his locomotive that attracted so much attention a dozen or more years ago, and it has lately been adopted with very good results on two or three of the English roads. Other special features of No. 20,000 are that it carries the Vanderbilt boiler and tender. In the former the firebox is cylindrical and corrugated, and in the tender the water tank is cylindrical, and the coal box is built at the front end of the tender and is, therefore, very conveniently placed for the fireman. The locomotive weighs in working order 176,510 pounds, of which 127,010 pounds are on the driving wheels. The weight of the tender loaded is 99,000 pounds. The driving wheels are 73 inches in diameter and the cylinders are 15 and 25 in diameter by 26 inches stroke. The boiler has a total heating surface of 2,793 square feet, of which 128 square feet are in the firebox.

VENT-CLOSING VALVE FOR PUMPS.

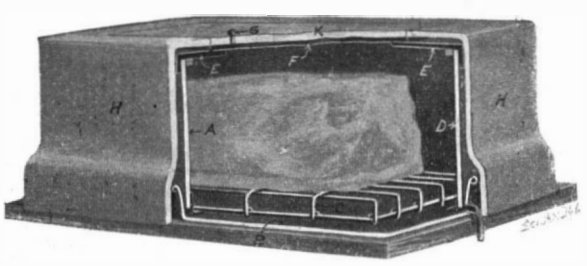
The device here illustrated is designed for use on pumps operated by windmills, and provides a means for closing the vent-hole of the supply-pipe of a pump whenever desired. It is well known that considerably more work is required to pump a given quantity of water when the vent-hole is open than when it is closed, thus prematurely wearing out the pump and windmill. With this device extra wear is entirely avoided, as the vent-hole may be readily closed whenever it is desired to use the pump. In our illustration the vent-hole may be seen at *A*. A metallic strip, *D*, encircles the pipe and is tightly clamped at the rear by a bolt. A portion of this strip directly in front of the vent-hole is off-set or struck-up from the surface of the supply-pipe to permit the insertion of a slide, *C*. To prevent leakage a packing of leather, *B*, is placed between this slide and the pipe, against which it is clamped. After the slide is inserted ears are turned up on its lower portion, and serve as stops to limit its upward movement. A rod passes through the upper end of the slide and serves as a handle to operate the device. This rod passes through a slot in the base, *G*, of the pump and is provided with a small detent or catch at *E*, which hooks over the pump base and serves to hold the slide in its highest position. When the slide is in this upper position the vent-hole is uncovered. If it be desired to close the opening, a forward pull of the handle-rod releases the slide, and it may be lowered to close the vent-hole. The valve, as has been shown, is of very simple construction and may be easily applied to any pump. Mr. J. E. Penner, of Kinbrae, Minn., has just received a patent for this device.



A SIMPLE DEVICE FOR PUMPS.

FOLDING ICE-BOX.

An article which should be of particular value for travelers and also for nurses who have charge of children has been recently invented by Mrs. J. B. Rogers, of Lakewood, New Jersey. The invention relates to an ice-box which may be folded up and packed away in a small space whenever desired. Our engraving shows the ice-box set up in position for use. Side leaves, *A*, and end leaves, *D*, are hinged to the bottom of a waterproof pan, *B*. A flanged top-piece, *E*, serves to hold the leaves in vertical position, their upper edges being wedged between the flanges and blocks on the under surface of the top, *E*. A lid, *F*, covers the opening in the top-piece to which it is hinged, and is provided with a knob, *G*, by which it may be raised. A jacket, *H*, of thick felt covers the ice-box and a flap, *K*, of the same material covers the lid, the felt serving to prevent the entrance of heat from external sources. A grid, *C*, placed in the bottom of the pan, *B*, serves to hold the ice and permit proper drainage of the same. The pan is provided with a drain-pipe to which a rubber hose is attached for drawing off the water. When desired, however, this rubber tube may be removed and the drain pipe closed by a cork or stopper.



A HANDY ICE BOX.

To fold the ice-box, the felt jacket is first removed, then the top, *E*, is taken off, the grid, *C*, lifted out, and the leaves, *A* and *D*, folded over. It will be noticed that the side leaves, *A*, are hinged at a higher point than the end leaves. The purpose of this is to permit the side leaves to fold over and lie flat on the end leaves. The grid is now placed on the folded leaves and is covered by the top-piece, *E*, thus forming a neat and compact parcel. When in position for use there is ample room in the box for bottles or other articles to be kept cool and it is therefore an accommodation which travelers will find indispensable.

Correspondence.

Seismic Disturbances and the Isthmian Canal.

To the Editor of the SCIENTIFIC AMERICAN:

The point urged, in the SCIENTIFIC AMERICAN of this date, in support of the Panama Route for an Interoceanic Canal, is hardly a safe one to insist on. Volcanoes are safety valves; the regions where they are are no more to be dreaded than are regions within the seismic belts where volcanoes are absent or remote. You would not advise a friend to select as his home an apartment house where the steam heating boiler had no safety valve, in preference to one where a safety valve was provided. The cases are perfectly analogous. Ometepe, Lago Nicaragua, is a safety valve at any rate. Nicaragua has not such subsidence shocks and surface undulations as has Panama, where there will never be a period of quiescence of sufficient duration to half finish the Bohio dam.

I realize that "geologists" galore have gone to Panama and reported that they did not feel earthquakes. So a man may go to Mississippi in January and say he saw nothing of negro disfranchisement—they don't vote there in January. Visitors of the "eminent scientist," the newspaper posing sort, stay on the Panama Isthmus, as a rule, less than a week. If they will go there, live with the people, camp out in the hills, as have I as an exploring naturalist, they will tell, if truthful, a very different story. Panama does have sudden shocks and quivers that would crack the pyramid of Cheops in twain; no Bohio foundations, on sand and 150, or more, feet below sea level, will ever withstand one such shock. Were there open volcanic vents near by these would be reduced or be wanting. The man who denies this has either never been long on the Isthmus, or—he is in the pay of the Panama people.

Remember Jamaica in the eighteenth century. Not in present geologic times has that island had a volcano in activity. Yet the fates that overtook Port Royal and again Savanna la Mar were far beyond that at St. Pierre in their terrible effects.

Mont Pelee's recent exploit may suffice to prevent the building of the Nicaragua Canal; it is not needed to prevent that at Panama. God himself could not build that and make it "stay put" without transcending His present laws. EUGENE MURRAY-AARON.

Washington, D. C., May 24, 1902.

The Current Supplement.

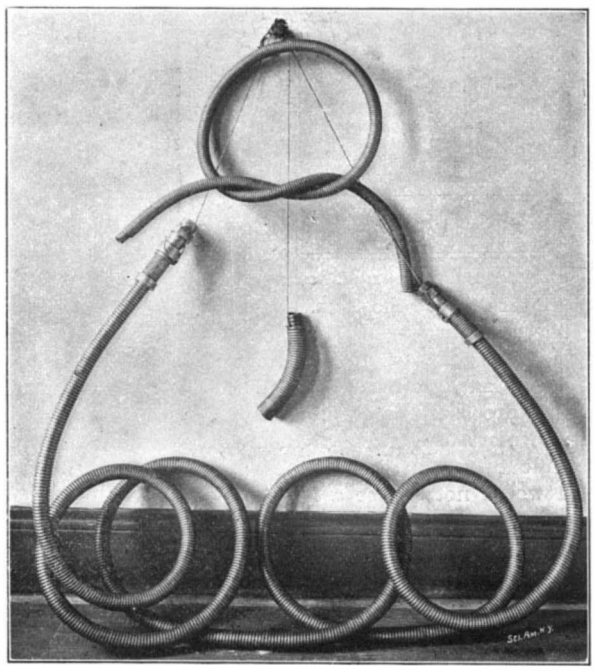
A very beautifully illustrated paper by Dr. F. A. C. Perrine, D. Sc., on the "Power Plants of the Pacific Coast," opens the current SUPPLEMENT. Messrs. Swinburne and Cooper's paper on the "Problems of Electric Railways" is concluded. Mention has been made in the SCIENTIFIC AMERICAN of the Richards-Archibald method of studying growing crystals by instantaneous photography. Messrs. Richards and Archibald's method is published in full. The famous Berthelot tells something of the radio-activity of matter. Naval affairs have not been neglected. Mr. William Laird Clowes describes recent scientific developments and the future of naval warfare; and S. W. Barnaby discourses on torpedo-boat destroyers.

An Improved Form of Apparatus for Producing Thin Films by Electro-Deposition.

Herr Endruweit, of Berlin, has patented an improved form of apparatus for producing thin films by electro-deposition. An endless metal band is first coated with potassium sulphide, and, after washing, is passed through a nickel bath of the usual composition. The thin film of nickel obtained in this way is backed by copper (by passing through a similar bath containing a copper salt in solution) and by tough paper, before being stripped from its support. A strong sheet or roll of paper faced with bright metallic nickel can be obtained in this manner, and the use of this material after relief-stamping and coloring, for wall-papers and for advertisement show-cards is said to offer many advantages. The electro-deposited "paper" is also reported to be useful for packing the stuffing boxes of high-pressure steam engines, and, if sold at reasonable rates, it is possible that there are many uses for which it may prove suitable.

HOSE MADE ENTIRELY OF METAL.

Metal is about the last thing one would regard as a substitute for rubber, and particularly where great flexibility is a quality which was absolutely essential; but this has been done recently, and a hose has been manufactured out of a steel tape which has all the flexibility of a tube made of rubber, and also several



METALLIC HOSE.

advantages which the rubber does not possess, such as great durability in all classes of service and the power to resist the action of heat and corrosion as well as that of acids and other chemicals. It is therefore adapted to the conveying of steam, compressed air, water, oils, acids, alkalies, gases, benzine, naphtha and gasoline.

No rubber whatever enters into the manufacture of this hose. It is constructed entirely of a metal tape which is rolled up in the form of a spiral, so that the edges overlap and fit into each other without in the least interfering with its flexibility. As the tape is rolled up it forms a groove for the reception of a packing which is completely inclosed in the metal as it rolls, where it remains fully protected from external or internal wear and tear. The packing causes the tubing to be perfectly tight, while the jointing induces a flexibility superior to that of a rubber hose of equal dimensions. As this hose will not kink, crust or blister, it can always be relied on to deliver its full capacity, which is greater than that of a rubber hose of the same dimensions, from the fact that the connections are all made on the outside, leaving the full internal diameter of the hose always available. The accompanying cuts show some pieces of this hose tied in such knots as to demonstrate its extreme flexibility, and also show the method of construction. In the latter the packing is shown in its place.

The single hose is recommended for all ordinary purposes; but where it is designed to convey air or steam under pressure, a double hose is made which will, it is claimed, resist a pressure of three thousand pounds to the square inch. This is constructed by placing one metallic hose within another, the coils of each running in opposite directions. This combination enables it to withstand the hardest usage successfully. While this hose is just being introduced into this country it has been in actual use long enough in Germany, where it originated, to demonstrate its serviceability. It has been adopted by the German navy and by the North German Lloyd. It has also done excellent service at the Liverpool docks, where over one thousand feet of it are used to convey steam from the boilers to the grain elevators.

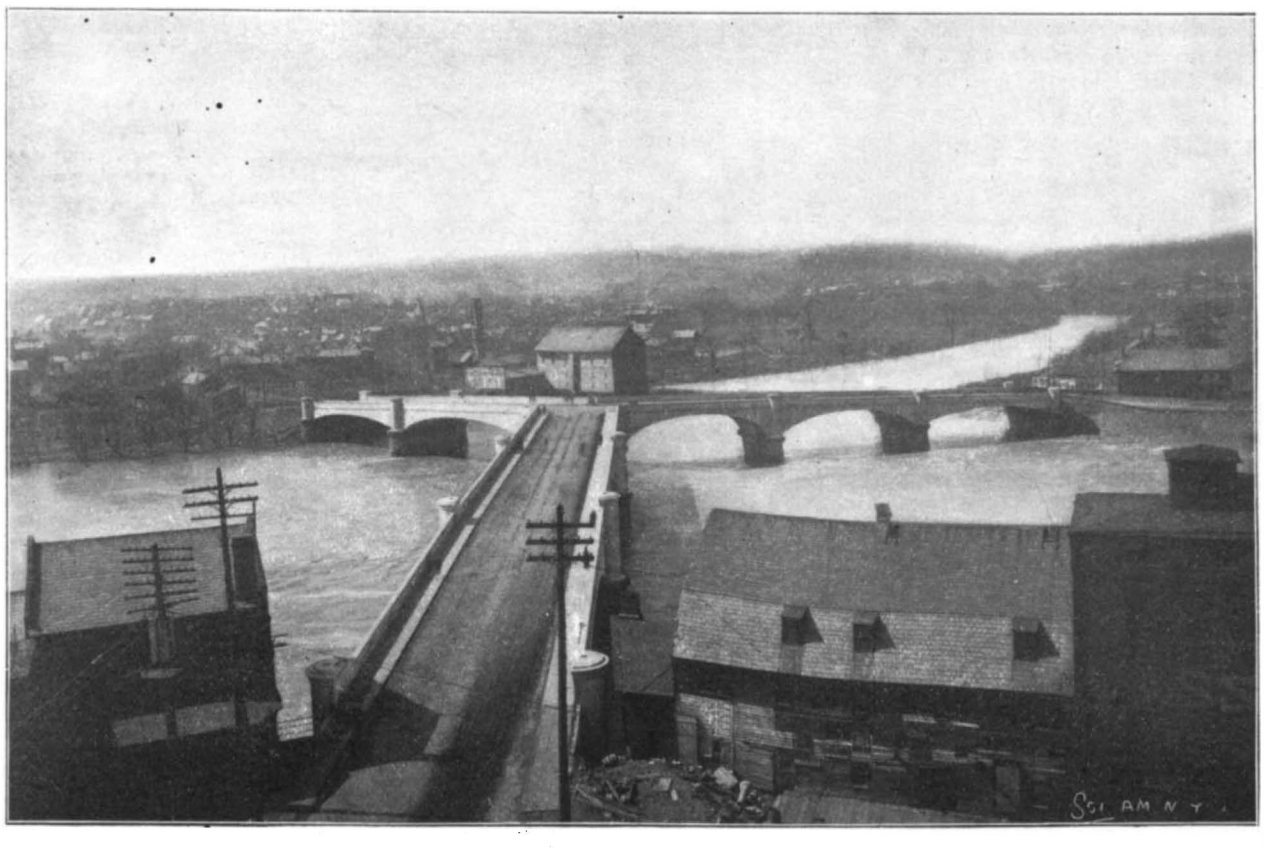
Metal hose cannot, like India rubber, be drawn over the end pieces of the apparatus with which connection is to be made. When of small diameter and intended for light pressures it is fixed by means of special connecting pieces which are cemented or soldered to the hose. In the case of larger hose, and where heat is to be encountered, the fittings are similar to glands in general use for valves and piston rods on pumps and engines.

CURIOUS BRIDGE AT ZANESVILLE, OHIO.

A bridge has recently been completed at Zanesville, Ohio, which is probably the only structure of a similar shape in the United States, if not in the world. It is popularly known as the "Y" bridge, from the fact that it consists of three arms, which join at the confluence of the Muskingum and Licking rivers.

It takes the place of a wooden covered bridge of the same design which was torn down in 1901 because it had become so weakened as to be dangerous for traffic. The site of the former bridge was utilized, but larger piers were constructed of masonry. Upon these was placed timber centering to sustain the steel ribs which constitute the permanent framework. The ribs are groups of pairs of bars, fifteen to an arch. A concrete filling consisting of gravel, sand and cement was placed upon the steel framework. Next to this was placed a layer of asphalt to prevent water from above reaching the tops of the arches, and upon the asphalt was laid a mixture of gravel, sand and cinders topped with another layer of concrete six inches in thickness. The roadway of the bridge is paved with brick and sustains the track for an electric railroad, the rails of which are bolted to steel channels embedded in the concrete. Conduits are also arranged under each sidewalk for electric and telephone wires as well as gas mains.

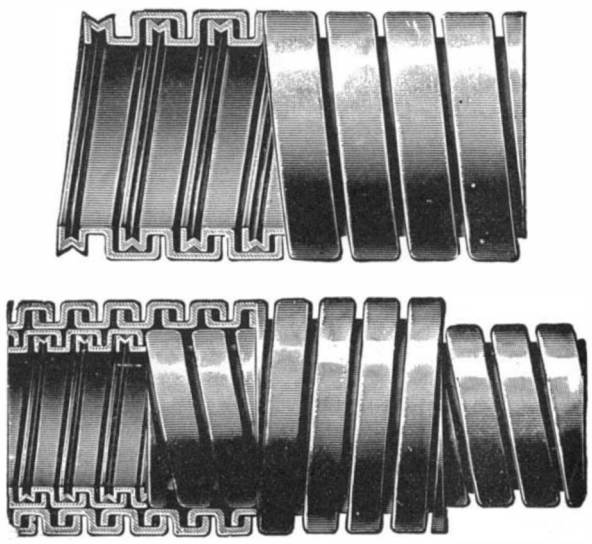
The east arm of the bridge is the longest, consisting of three spans 122 feet in length. The west arm is composed of spans 120½ and 99 feet in length respectively, while the north arm is composed of three, each of which is 81 feet in length. As is noted by the illustration, the arch rings are elliptical, while the piers sustaining them are finished with half-round columns or buttresses intended to support poles for electric lamps. Only the exterior of the piers is composed of masonry, the space within being filled with concrete also.



THREE-ARM BRIDGE AT ZANESVILLE, OHIO.

What it Costs to Keep Central Park in Condition.

The landscape gardener of New York city, Mr. Samuel Parsons, has drawn a gloomy picture of the future of Central Park, New York's famous pleasure ground. According to Mr. Parsons, about two million dollars will be required to save the park from ruin. The magnificent elms which line the Mall are said to be slowly dying for lack of nutrition. The removal of dead leaves in the interest of cleanliness has done its share to expose to the parching rays of the sun a soil which is in itself not over-nutritious. Mr. Parsons naturally hesitates to demand two million dollars for the saving of the park. Indeed, it is a question whether it is not advisable to abandon the park altogether, and to seek another spot which might be converted into an open-air pleasure ground for the people. Property owners have for years complained that the peculiar situation of the park, splitting the city as it does in two long halves, necessitates detours and causes not a little inconvenience. That the park will sooner or later give place to the all-devouring business needs of the city is hardly to be questioned, lamentable though that fact may be. Mr. Parsons is against the selling of the park for building lots, because in his opinion it is the most beautifully laid out property of its kind. In France and Germany are also magnificent parks, but it is doubtful if they can compare with the magnificent expanse of green that extends from 59th Street to 110th Street. But in one thing at least foreign parks excel us. Their vegetable growths are



more scientifically kept, with the result that there is little or no danger of denudation.

In times past a lake existed in Switzerland near the Marsby Valley, but either dried up or disappeared through drainage or analogous causes. Now several cantons have combined, and will fill the ancient lake-site by water from mountain torrents now going to waste near by. The head thus obtained will amount to 600 feet, and will afford 60,000 horse power. The work will take three years to execute, and is expected to cost about eight million dollars.

To Prevent the Freezing of Gas Pipes.

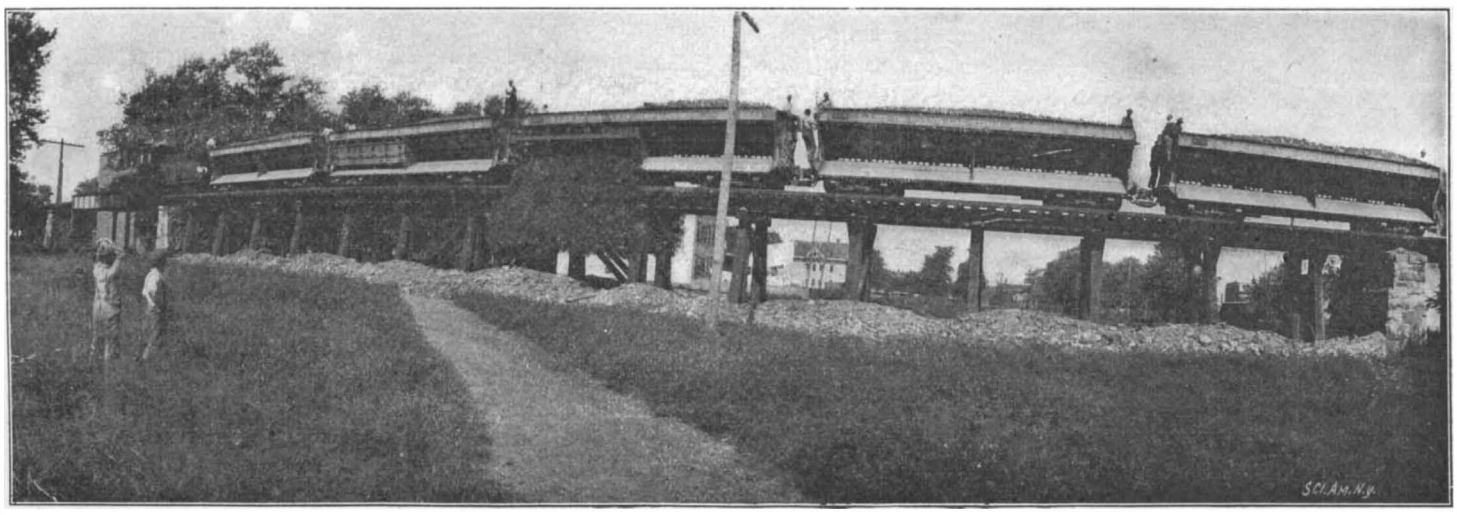
A simple but effective device for preventing the freezing of gas pipes is described in the Illustrirte Zeitung für Blechindustrie, consisting merely in the insertion of a wider piece of pipe just where the conduit issues from the ground or wall. For a conduit of a diameter from ⅜ to ½ of an inch a length of from 20 centimeters to 30 centimeters of a pipe 1 inch in diameter suffices. The deposition of the water particles contained in the gas, which on leaving the works have a temperature of about 10 degs. C., naturally takes place just where the gas is subjected to the most abrupt change of temperature, i. e., on its issue from the ground. If the external temperature is sufficiently low, the deposited water immediately congeals and clogs the conduit. As soon as the gas has acquired the temperature of the conduit the deposition of water and congealing cease, and this is said to be the case a short distance beyond the first cooling point. Therefore there should be no congealing beyond the inserted wider piece, and this piece is wide enough to accommodate a thick ice-crust and to still leave a free passage for the gas. As a matter of fact, the principle of this new method is already employed in street lamps, and with success. Anyhow, the expense involved is trifling, and it well merits a trial.

It is three hundred years since Bodley built his library at Oxford and the university is going to celebrate the anniversary. The Bodleian is the largest university library in the world, and ranks next to the British Museum and the Paris Bibliothèque Nationale in the number of volumes.

SELF-DUMPING CARS IN RAILROAD CONSTRUCTION.

BY DAY ALLEN WILLEY.

Some remarkably rapid work in the building of railroads in the West has recently been accomplished by the use of labor-saving machinery and appliances such as self-dumping cars, the track-laying machine and the bridge-building traveler. The country through which some of the lines have been constructed is of a very difficult character, and necessitated the filling of valleys or canyons with earth or stone in addition to the erection of many long and high bridges. Such an enormous quantity of material was required to fill around the false work placed across some of the valleys that the unloading of the cars in the usual way by shoveling was out of the question, as too much time would be lost in the work. In some places embankments ranging as high as 150 feet were required to carry the track across the valleys. In their construction a wooden trestle would be built from the side of the valley a distance of 50 to 100 feet, according to depth, and a temporary track laid on this support.



DISTRIBUTING MATERIAL FROM SELF-DUMPING CARS ON A TRESTLE.

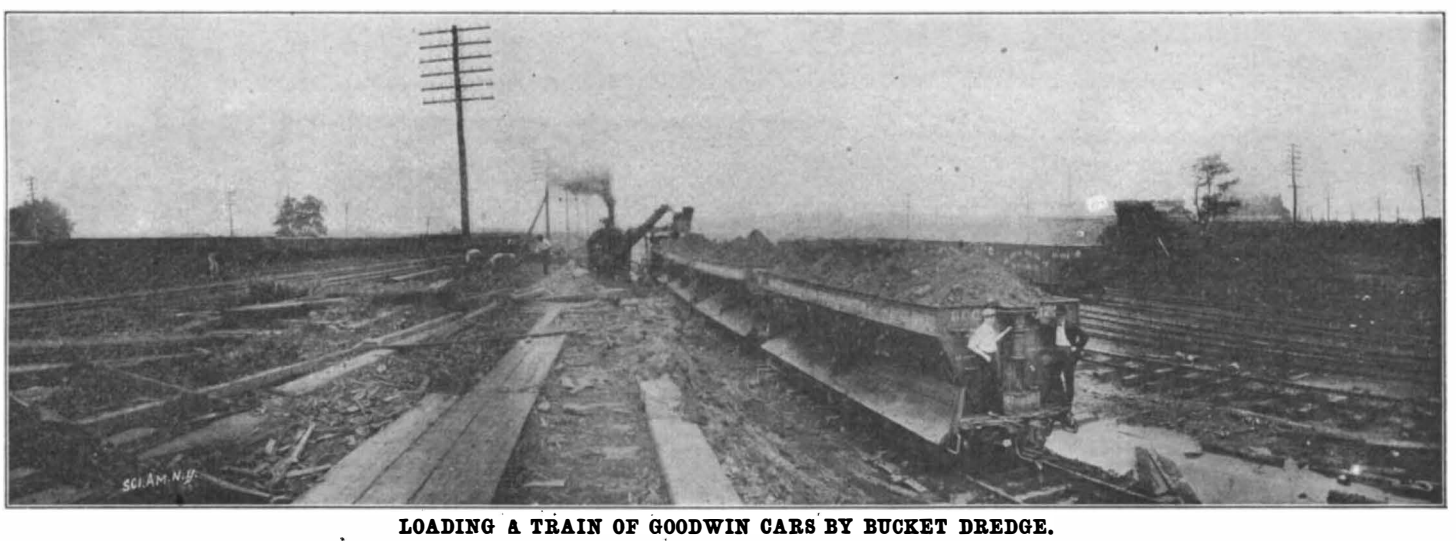
From the nearest gravel pit or cut trains of construction cars would be run out on the trestle and contents dumped. From an engineering standpoint the work performed by some of the self-dumping cars was remarkable. What is known as the Goodwin was employed by a number of the contractors. This car is built of steel, with the lower half of a V-section. Each side is hinged, and may be swung in and fastened or released at the will of the operator. The movable framework holding the sides in place is connected with valves or "dump cylinders" operated by compressed air, the ordinary supply furnished for the air-brakes being usually sufficient to operate them.

The car can be arranged so as to open one side or the other or both. When it is loaded it is run out upon the trestle or false work, and by merely pulling the dumping lever, as it is called, the sides are opened and the contents of the dumper thrown in the center of the track or on either side as desired. Only one man is required to empty a train of five or six cars after the mechanism for directing the motion of the contents has once been adjusted. By coupling the air-hose to the dumping cylinder on the end car one man, by shifting a lever, can dump a train of half a dozen or more cars.

By utilizing this form of car 10 to 25 cubic yards can be thrown on the embankment from each side in merely the time required for the material to pass out—usually a few seconds. As the lower portion of the false work is filled an addition to the trestle is constructed and more cars added to the dumping train. If more material accumulates on one side of the trestle than on the other it is only necessary to keep one side of the car closed and divert all of the filling to the lower, shallower part of the bank.

When the level of the road-bed is reached the track is laid with rails of the usual size, and the cars utilized to ballast it. Loaded with rock or gravel, they are hauled over the rails to the desired point, and by the single motion of the lever the material can be thrown, not only on one side of the rails to the required distance, but also between them so evenly that a few minutes' work with a shovel is sufficient to place the road-bed in condition for regular service. An interesting feature in connection with the ballasting is the rapidity with which the work is performed. In case time is precious it can be discharged from either or both sides while the locomotive is pulling the cars at a speed ranging from 5 to 12 miles an hour. For completing the surface of the road-bed it was found in the work above referred to that the distribution was very satisfactory even at the latter rate of speed.

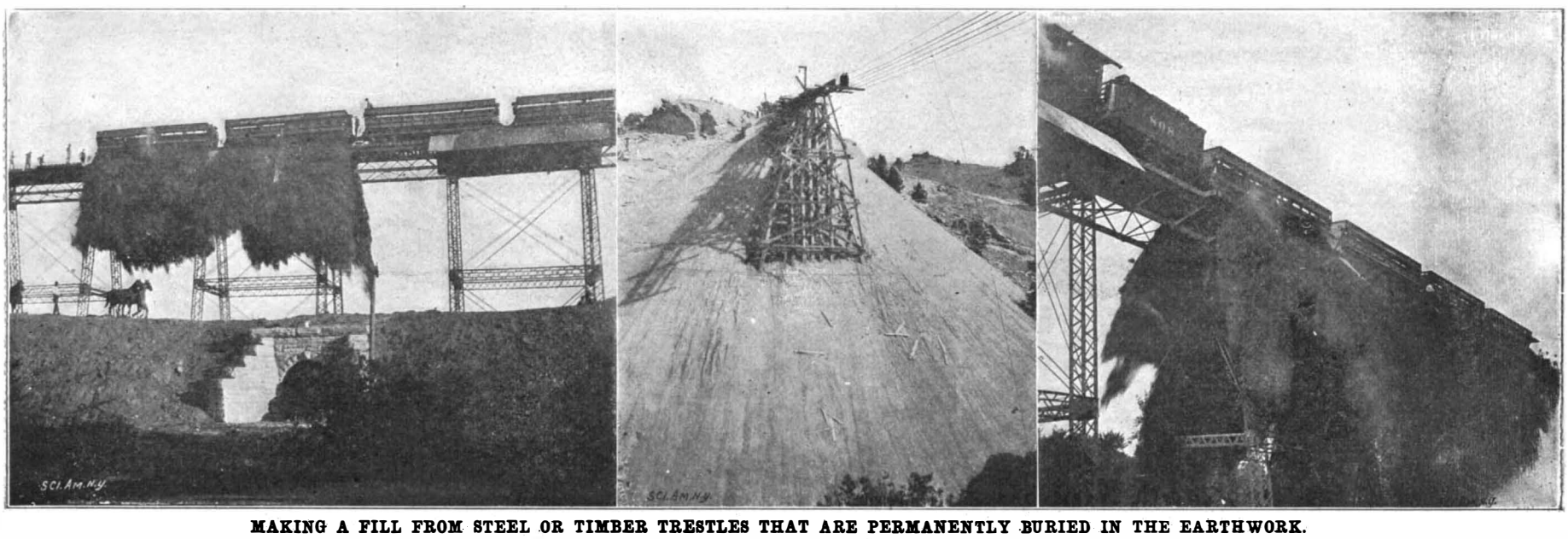
To give an idea of the load which can be transferred in not only constructing railroads, but loading vessels with coal or other material, it has been found by actual test that five canal boats each 300 feet in length can be filled at a time, provided, of course, that they are lying along the same wharf. With the usual number of hatches to a boat about forty cars of ordinary size can be placed on the wharf, one to serve each hatch. As already stated, an indefinite number of cars can be unloaded by one man by merely connecting the hose which carries the compressed air to one of the dumping cylinders, consequently as soon as the cars are in position their contents can be emptied into the hold simultaneously. The sides of the unloaded car are replaced in position and locked, and the empty train drawn from the wharf, when another takes its place. Allowing for the movement of the cars to and from the wharf, and the unloading, a train load of from 1,500 to 2,000 tons can be transferred in less than ten minutes, or at a rate of fully 10,000 tons an hour. If the tracks connected with the shipping wharf are extensive enough to allow trains to be made up and hauled without delay this rate of unloading can be considerably increased.



LOADING A TRAIN OF GOODWIN CARS BY BUCKET DREDGE.

At rear of last car is shown the air-cylinder by which sides of car are released.

The mechanism operating the sides of the self-dumping car is graduated so that the opening can be varied and the flow of material diminished or increased at the will of the operator. This is especially desirable in reballasting track. When but a small quantity of gravel or rock is required to properly level the road-bed in such work the ballasting train can be moved as rapidly as 16 miles an hour. This rate of speed has been maintained and the work done successfully in improvements upon the Great Northern Railway, where rock as well as stone was discharged at the same time. As six men require about thirty minutes to unload the average-sized car, an idea of the time and labor



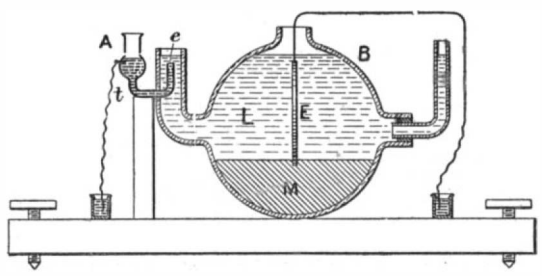
MAKING A FILL FROM STEEL OR TIMBER TRESTLES THAT ARE PERMANENTLY BURIED IN THE EARTHWORK.

The above snapshots were taken as the material was dumped from the cars.

saved by the automatic process can be gained. The accompanying photographs showing the work of making some high fills on the Union Pacific and other railroads are particularly interesting in view of the excellent "snap-shot" effects secured.

NEW FORM OF LIPPMANN ELECTROMETER.

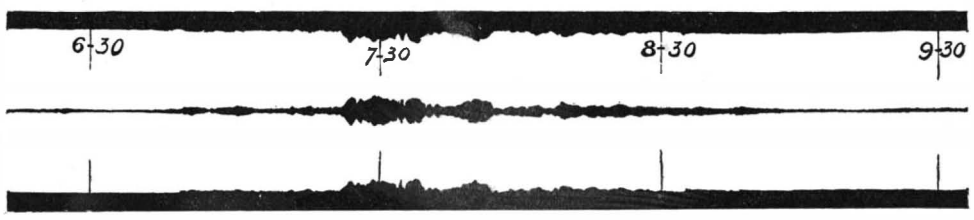
A new form of Lippmann capillary electrometer has been devised by M. Pierre Boley, of Paris. It has the advantage of being easy to construct and is at the same time very sensitive, as it will indicate differences of potential as low as 1-3000th of a volt. As the diagram shows, the mercury is contained in a pipette, *A*, whose lower tube, *t*, is bent twice at right angles. The tube has a diameter of one millimeter at the open end, *e*, and here the meniscus is formed. The end of the tube is surrounded by the electrolyte, *L*, contained in a spherical vessel, *B*, which has a tubulure at each end; that on the left brings the liquid above the meniscus, and enables the latter to be observed by the microscope eyepiece, while the right-hand tube, which turns in the stopper, renders it easy to empty the vessel. The electrode, *E*, is fixed upright in a base of putty, *M*; it has a diameter of 4 inches, and on this account it is not easily polarized. The meniscus is lighted from above so as to produce in the microscope two or three black fringes parallel to the image at its summit. The cross wire is brought upon the fringe nearest the mercury, which is the most sharply defined. To measure the electromotive force a Latimer Clark standard cell is used with a compensator which brings the reading back to zero. The image of the meniscus is seen to depress with a change in the electromotive force of only 1-3000th of a volt. For instance with a meniscus of one millimeter diameter, the apparent depression is about ⅛ of a millimeter for an image which is magnified 100 diameters. The instrument obeys a simple law for increasing electromotive forces, as up to 1-100th of a volt the depression is exactly proportional to the electromotive force. The zero of the instrument remains always fixed when it is mounted, so as to be free from vibration.



LIPPMANN'S ELECTROMETER.

EARTHQUAKE RECORDERS IN AMERICA.

In connection with the recent volcanic eruptions in the West Indies and the disastrous earthquake in Guatemala, it is interesting to know that several instruments for observing and recording earthquakes are in service in various parts of North America. One is located in Baltimore, one at Toronto, three at Bayonne, New Jersey, and one at Victoria, British Columbia. Although the seismograph at Baltimore has been in operation only since April, 1901, it has noted a number of disturbances of the earth, the last being that which so seriously affected Central America. The instrument is of the form designed by Prof. John Milne, the noted geologist, and consists of a so-called horizontal pendulum, that is, a beam supported by a vertical column as a door is hung by its two hinges. The line between the two points of support of the beam is nearly, but not exactly, vertical; the more nearly vertical it is the more sensitive is the beam to slight tremors. A small tilting of the column at right angles to the beam will cause the latter to swing in that direction. The adjustment is usually made so that a tilting of the column of ½ sec. of arc (i. e., a movement of the top of the column, which is about one foot high, of 1-35,000th of an inch beyond the base) will cause the end of the beam to swing a distance of 1-25th inch. The beam is 37 inches long, and on its end is fastened a plate of thin brass in which is a narrow slit parallel to the length of the beam; this plate moves over a fixed brass plate with a similar slit, but at right angles to the former. A ray of light is reflected through the two slits, which simply serve to narrow it, and moves to and fro as the beam swings. The light falls on a strip of bromide paper which is steadily moved by clock work under the slits at the rate of 1-25th of an inch a minute. When the beam is at rest the movement of the paper causes the light to trace a straight line upon it, but when the beam swings back and forth the straight line is changed into a sinuous curve. The period of vibration of the beam is about fifteen seconds, during which time the paper has only moved about 1-100th of an inch, consequently the curved line is very much compressed, and its back and forth tracing on the paper appears like the widening and paling of an original straight line. The instrument is mounted on a solid brick pier. built about twenty-five years ago, and consequently rests upon a very solid foundation, as the pier stands on the clays and gravels of the Potomac Formation, which rest on crystalline rocks seventy or eighty feet below the surface. The beam points about S. 30 deg. W. This direction was chosen so that the beam might be parallel to the Appalachian mountain system and to the coast line, and thus be most sensitive to disturbances propagated at right angles to these continental features. It is in charge of Prof. Harry Fielding Reid, of the faculty of the Johns Hopkins University, and by a strange coincidence made its first record on the same day it was completed and placed in operation. This was an earthquake which was very perceptibly felt upon the Pacific Coast as well as at various points on the Pacific Ocean, and the record of the instrument shows more or less movement of the earth for a period of nearly four hours. Reproductions of this disturbance upon the photographic paper correspond almost exactly to that noted when the disaster in Guatemala occurred, although the Central American fluctuations were somewhat more violent, as indicated by the wave lines indicating the vibration of the instrument. Although many trains pass through the Baltimore & Ohio Railroad tunnel within 150 feet of the instrument, the vibrations caused by the service are so rapid that the seismograph is not affected. Scientists who have confidence in the construction of the instrument believe that the eruptions at Martinique and St. Vincent have been confined to a small area, as the record at Baltimore has given no trace whatever of disturbance since these eruptions.



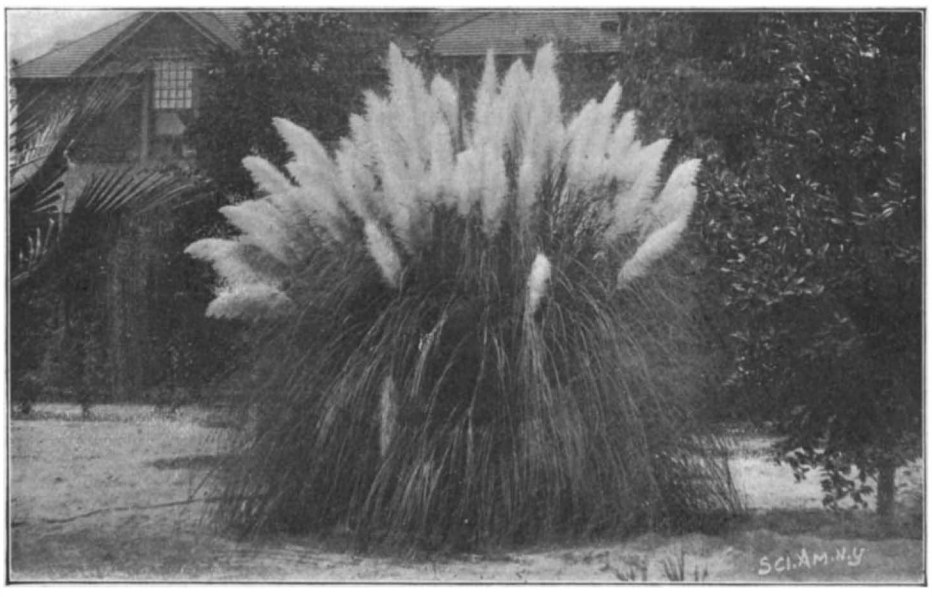
PHOTOGRAPHIC RECORD OF AN EARTHQUAKE MADE BY SEISMOGRAPH AT JOHNS HOPKINS UNIVERSITY

This instrument gave no indication of the West Indian disturbances.

THE UTILIZATION OF PAMPAS GRASS.

BY CHARLES F. HOLDER.

Thirty years ago the pampas grass was a curiosity. Many New England homes had treasured specimens which were brought across the seas as souvenirs from the vast pampas lands of South America. Now the pampas plume has been introduced into America, and in California forms one of the standard crops. The vast fields of grass in its light gray tints present a beautiful scene, rippling in the wind, the soft colors and graceful shapes being particularly pleasing to the eye, and when seen in long stretches, as on the Rancho del Fuerte near Whittier, a more attractive sight can hardly be imagined. Yet the full beauty of a pampas field in perfection is never or rarely seen in California, as the plumes are gathered before they are perfectly ripe and white.



PAMPAS GRASS, SHOWING THE HIGHLY DECORATIVE EFFECT OF THE PLUMES.

Santa Barbara county is the region most famous for this grass, and here the first experiments were made with it, the roots having been brought, it is said, in the early sixties, from South America by a Spanish gentleman. It was soon seen that the pampas plume in the United States would be a profitable venture, and when it was found that the plants would live, roots were imported and many acres planted in various parts of California, resulting in the pampas ranches of to-day. One of these is found south of Pasadena, over the Mission hills, owned by Mrs. Strong, the pioneer of plume raising on a large scale, the first to introduce the plumes as part of the regalia of political clubs. Their use by tens of thousands in the Blaine campaign gave significance and novelty to the ranks of the followers of the Plumed Knight, each of whom bore one of the attractive plumes.

The plumes have no special economic value aside from their use as ornaments. They are dyed all colors of the rainbow, jet black and silver, and bring a good financial return in the large cities and in the localities where they are not known. Thousands of plumes are thus employed all over this country and Europe, Germany especially being an important field for the plume. Of all the enterprises in California, this is one of the most æsthetic. The orange picking and packing is interesting to the average tourist, the great groves with their golden fruit being always a fascinating sight, but the pampas plume is so dainty that it appeals particularly to the artistic.

The ranches or plume orchards are planted from roots often obtained direct from South America to renew the stock in its full vigor, but the roots are easily obtainable in California. These are planted a third farther apart than ordinary fruit trees, as the plants grow to enormous size. Like the tobacco, it is exhausting to the earth, sapping it of its moisture and richness, and taking so firm a hold upon the soil with its mass of roots that only dynamite will blow it out. The pampas plume farmer plants them in hills ten by sixteen feet apart, each hill representing five or six individual plants which appear to the casual observer to be one enormous bunch. The first year a few plumes will be seen; the second and third each hill may be counted on producing from 50 to 200, and the fourth and fifth and sixth years see a fine crop, the plant now being, if the conditions are perfectly favorable, nineteen or twenty feet high and twelve or more across. The ground is kept weeded, and after the fifth year old stock is weeded out, the best results coming from plants between four and five years of age. In the high lands, where the plants are exposed to the warm rays of the sun and evaporation is rapid, the plants are irrigated once a month. In September the picking begins about the time of the vintage, and on the large pampas plume ranches, troops of Mexicans or white laborers can be seen trimming the grass. As soon as the tips of the grass begin to appear, they are cut and carried to the tables where women pull off the sheaves, skilled hands making $1.50 per day at the work. Children now take the plumes and lay them in long rows in the sun to dry and bleach. When the industry was in its incipiency, it was doubtful if it could be made a success, as the plumules dropped off and it was impossible to transport the plumes, but someone discovered that if the plume was picked when it was not quite ripe it would hold together, which solved the entire problem.

In sunny localities a day or so suffices to dry the plumes, and at such times the ground appears, from the hills, to be covered with snow. After the drying the plumes are taken to the curing house and then finally sorted into various grades by expert hands. The finest and most beautiful plumes are about thirty-six inches long, and they are packed for shipment either in packages of 2,000 or in large cases, the prices ranging from $200 to $50 per thousand, according to the demand.

There are numerous pampas orchards in California ranging in their productive quality from 5,000 hills, which produce 250,000 plumes, down to small ranches where but a few are raised. In all, California produces about 2,500,000 plumes per annum, which are sent all over this country and Europe.

The pampas grass is the *Gynerium argenteum* of botanists, and is indigenous to the La Plata region of South America, covering large portions of the pampas and forming a characteristic plant of the country. In Southern California the pampas is a common garden plant, being very effective against the rich green foliage. During the yearly fiestas of Los Angeles, Pasa-

dena and Santa Barbara, many of the vehicles are decorated with the plumes. One which secured the prize at Santa Barbara is shown in the accompanying illustration. It was completely covered with pampas plumes, presenting a beautiful sight as it moved slowly along; even the umbrella over the head of the driver being formed of this attractive grass.

AN ANTIQUE BRONZE HEAD OF THE ROMAN EMPEROR TIBERIUS.

During the work of excavating for the foundations of the new building of the Opera Pia di San Paolo, the pawnbroking and loan establishment in the Via Monte

BRONZE HEAD OF THE ROMAN EMPEROR TIBERIUS EXCAVATED NEAR TURIN.

di Pietà in Turin, a well-preserved bronze head of Emperor Tiberius of Roman days was discovered. It was found August 24, 1901. Although oxidized and covered with a faint green deposit, it shows manifest traces of gilding in the sockets of the eyes, in the ears and in the hair. The metal of the head has a thickness of three millimeters. The head measures twenty-six centimeters from ear to ear and twenty-nine from brow to chin. The features are excellently executed, and are of manly beauty, the nose slightly aquiline and the hair curly and short. This valuable find lay at a depth of about six meters below the level of the street, in an ancient well, which had to be removed to make way for the foundations. This, coupled with the fact that the head shows signs of breakage at the neck, led to the conclusion that it belonged to a complete statue and was robbed and thrown into the well. It is possible that the head belonged to an equestrian statue, since the foreleg of a horse and the right leg of the rider were found in 1559, when the Church of the Holy Martyrs was being built near this site. These two objects are now in the Museum of Antiquities in Turin.

Close beside the head of Tiberius, a Cupid of white marble was found, the whiteness of the cleavage having lost none of its original purity. The fracture shows a clean, granular and shining white. It is to be regretted that the statuette has lost its head, the left arm, the right forearm, the left leg and the right foot. Both finds have been temporarily deposited in the Opera Pia di San Paolo, but will doubtless be presented to the Turin Museum of Antiquities, which contains many valuable relics.—For our engraving, as well as the accompanying description, we are indebted to the Illustrirte Zeitung.

AN ANCIENT IROQUOIS RITE.

BY EDWARD HALE BRUSH.

If white men of a Christian nation see a great calamity impending, it is customary in public and in private worship to call upon the Almighty for protection. When the so-called "Pagan" Iroquois are apprehensive of trouble of any kind, they, in their simple, child-like faith in the power of a Divine Being or his agents, call upon him or them through their peculiar forms or ceremonies to avert the threatened harm. Iroquois annals are full of incidents of this kind. In the ceremonies of the New Year's festival at the Cattaraugus Reservation in Western New York in February, the Senecas of the "pagan" belief revived many ceremonies which had not been observed before in many years, or had not been executed with such faithfulness and one might say devoutness.

The unusually large attendance of Indians at the dances and other rites of the festival, and the unusual circumspection maintained in connection with the ceremonies, seemed to indicate something akin to that feeling of religious fervor noticeable at a revival meeting among white Christians. The object of this unusual care to carry out the old ceremonies was the pleasing of the Good Creator, Ha-wen-ne-yu, and the subordinate divinities or spirits to whom he is believed to delegate various offices and tasks, such as He-no, who has control of the thunder, the storm and the rain; the Three Sisters, the spirits whose especial care is the cultivation of vegetables which support life, and the spirits whose care produces the herbs used in healing the sick.

Thanks are given in the Iroquois ritual to all the objects in nature, many of which are enumerated by name. One of the leading features of the New Year's festival is the recitation by the "preacher," or "Master of Rites," as he is sometimes called, of an address or chant of thanksgiving to the Good Creator, between the clauses or stanzas of which the turtle rattles are played and the feather dance is performed. This dance is the most religious of all the Iroquois dances. Whatever significance its name originally possessed is lost in the dimness of a great antiquity.

In times gone by, this thanksgiving chant and the feather dance were associated with the ceremony of burning the dog. This year on the Cattaraugus Reservation there was at one end of the Long House a curious-looking pole. It was about ten feet high and was painted around with stripes of red, blue and green like a barber's pole; near the top hung a small bag or basket and a cluster of ribbons of different colors. When asked what this was, the Indians said in hushed tones that it was "the dog," that is, it had been put there to remind the worshipers of Ha-wen-ne-yu of the ancient rite, which more than twenty years ago was abolished on pressure from the whites, who considered it barbarous and cruel. Neither white men nor red remembered seeing such a thing as this pole in many years.

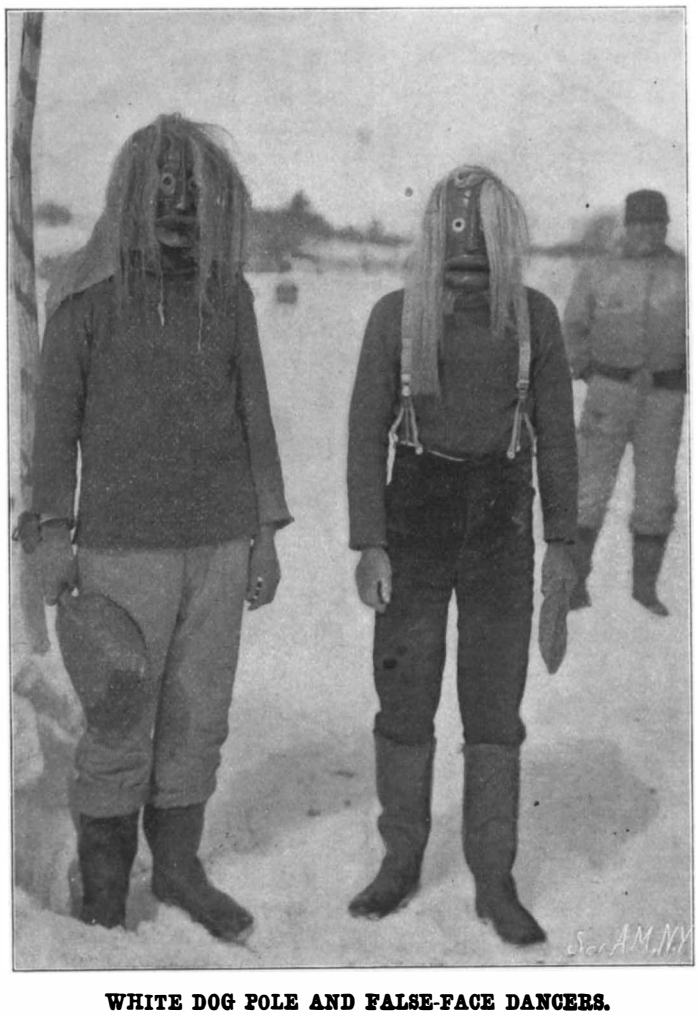
The accompanying picture of the white dog pole shows also two false-face dancers. The false-face ceremonies of the Iroquois were also observed with unusual faithfulness at the recent festival in February. The houses of the faithful were visited by the false-faces; and the false-face dance in the Long House was performed with all the ceremonies appertaining to it, including the burning of tobacco in offering incense to the Great Spirit and supplicating him to ward off the attacks of evil spirits, and including also the ancient ceremony of the scattering of the ashes.

In this ceremony the false-faces seize the ashes and glowing embers from the sacrificial fireplace, and holding them in their hands blow the hot smoke and ashes upon the heads of men and women who are there to be cured of disease by the spirits supposed to reside within the curious masks.

The significance of the decoration of the white dog pole, as described above, is apparent when the history of the white dog sacrifice is considered. It was customary in former times, after the animal had been killed by strangling, to deck its body with ribbons of many colors, with feathers and with wampum, and sometimes to paint stripes upon the body also. It was then hung from a pole near the Long House until the hour arrived for taking it within that structure for the sacrifice. In the time of the historian Lewis H. Morgan, the body of the dog was borne to the blazing altar upon a sort of bark litter behind which the people came in Indian file. Speeches and chants were made over the dog, the people joining in the ceremony. Tobacco was burned, as it still is at the New Year's festival; this, as already noted, being the Indian method of burning incense as an offering to the Great Spirit. It is supposed to be an offering especially acceptable to Him and to carry the prayers to His ears.

BRONZE HEAD OF THE ROMAN EMPEROR TIBERIUS EXCAVATED NEAR TURIN (FRONT VIEW).

The white dog sacrifice symbolized in this strangely ornamented pole was a very ancient ceremony, and its original significance is lost in the mist of antiquity, like that of many other Indian rites. At one time the custom of feasting upon its flesh, as that of a sacred animal, was associated with the sacrifice; and the ceremonies of the burning of the dog, as a whole, were anciently so peculiar as to call for especial attention from missionaries and early explorers, who made records of their observations as to the habits of the aborigines. One of the most interesting features of the ceremony is the fact that, while a sacrifice, it does not appear to have had the character of atonement for sin, in this respect being different from the sacrifices offered by the heathen peoples of the Old World and the animal sacrifices of the ancient Hebrews. The ritual connected with the ceremony, some of which survives to the present day, indicates that the chief, if not the whole, significance of the rite was the sending up of the spirit of the dog as a messenger to the Great Spirit to announce continued fidelity in His service and convey gratitude for the blessings of the year. The fidelity of the dog was typical of the fidelity of the Great Spirit's children. He was the trustiest messenger which could be found to bear to the Great Spirit the pledge of their fidelity to His worship.



WHITE DOG POLE AND FALSE-FACE DANCERS.

The wampum, always used in sealing treaties of friendship or any other formal contracts, was hung around his neck as a pledge of good faith. The last time the dog was burned on the Canadian reservation at Brantford, Ont., the Master of Rites sang, "Great Master, behold here all of our people who hold the old faith and intend to abide by it. By means of this dog being burned, we hope to please Thee, and that just as we have decked it with ribbons and wampum, Thou wilt grant favors to us, Thy people. I now place the dog on the fire, that its spirit may find its way to Thee who made it and who made everything, and thus we hope to get blessings from Thee in return."

While the dog hung outside the Long House, where the decorated pole stood this year, its spirit was supposed to linger about the body; but when the dog was placed upon the fire and burned, it ascended to Ha-wen-ne-yu, and conveyed to him the message from His faithful children.

It is a singular fact that though the sacrifice of the dog itself has for many years been abolished on the New York reservations, the ideas associated with the curious rite still retain their hold upon the devotees of the ancient Iroquois religion.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

PLANTER AND CULTIVATOR.—J. R. JONES, Jackson, Miss. A seed-box and fertilizer distributer are employed on this machine and means are provided for releasing and dropping the seed through the action of the fertilizer distributor to cause fertilizing material to be dropped upon or near the seed after it has reached the ground. Adjustment can be made whereby the fertilizer distributer will deposit a continuous instead of an intermittent drill.

ROAD-SCRAPER.—T. WILSON, Meyers Falls, Wash. The road-scraper is of such construction that a main and auxiliary draft beam are employed capable of adjustment relative to each other and to the blade or shovel whereby the dirt may be directed either to the right or left-hand side of the implement. The ground need not be turned up prior to the passage of the scraper over it, as the scraper will act as a plow as well an an evener.

Apparatus for Special Purposes.

INCANDESCENT VAPOR-BURNER.—E. L. FEE, Warren, Ind. This invention relates to improvements in burners of that class employed for burning gas for illuminating purposes formed from naphtha, gasoline, or other hydrocarbon oils. The object of the invention is to provide an incandescent burner of this class that shall be simple in construction and with which absolute safety is insured as well as perfect combustion.

Electrical Apparatus.

BLOCK-SIGNAL SYSTEM.—L. RIEBE, Lansford, Pa. This system is electrically-controlled and particularly adapted for street-railways having a single track with switches at suitable intervals. Simple mechanism is provided whereby a car in leaving the switch will close the circuit to signals at each end of the block, thus indicating to the motorman of a following car that a car is running on the main track between the switches. The system is so arranged that the car upon leaving the main track of the block will cause the signals to be reset to "safety."

Railway Improvements.

DRAFT ATTACHMENT FOR RAILROAD-CARS.—J. M. DONOVAN, Vicksburg, Miss. The invention relates to railroad cars having draw-rods extending from one end of the car to the other to connect with the draw-bars. An improved draft attachment is provided for railroad cars to insure easy drawing of the cars and to resist buffeting shocks, thereby relieving the car-body of undue strain and giving it longer life.

BRUSH.—F. BECKER, New York, N. Y. This brush is designed especially for use in connection with street railway tracks to clean them. These tracks, as generally constructed, have grooved rails which frequently become clogged with dirt so that it is necessary to scrape and brush them. Mr. Becker has invented a novel means for conveniently attaining this end.

Vehicles and Their Accessories.

WHEEL-HUB.—E. A. ROYCE, Excelsior Springs, Mo. The wheel hub has certain novel means for mounting it to turn with a minimum degree of friction. Various parts of the hub may be readily taken apart for repair and adjustment, and when one part has become worn, so that it no longer operates with perfect satisfaction, it may be easily taken out and a new part substituted without affecting the other elements.

BICYCLE.—H. C. WEEKS, Bayside, N. Y. The bicycle is provided with endless treads on each side of the wheel forming an inclined walking surface for the rider's feet to walk on, thereby imparting a traveling motion to the treads which is transmitted by gearing to the bicycle wheel. As the rider stands on the inclined treads, it is evident that not only the walking power is used for propulsion, but also the rider's weight, and by the rider pushing on the handle-bar, power is added to propel the bicycle at a very high rate of speed.

Miscellaneous Inventions.

EYEGLASSES.—A. B. CRITZER, San Antonio, Texas. The construction and manner of supporting the nose-pieces operate to project the whole eyeglasses upward in use. The nose-pieces are so arranged that they will operate freely and will not become clogged or damaged in any way. They yield laterally toward the lenses and also have a longitudinal movement independent of the lateral movement.

SNAP-HOOK.—A. J. TOWNER, Santa Ana, Cal. The invention in an improvement in the class of so-called "twin snap-hooks." Improved means are provided for opening and closing the two hooks and holding them closed together when in use. The device employed for this purpose is an eccentric which is peculiarly arranged and rigidly connected with the loop to which a strap is attached in practical use.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

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"U. S." Metal Polish. Indianapolis. Samples free.

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WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 2669.—For makers of broom corn seeding machinery.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 2670.—For makers of typewriting and carbon papers.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 2671.—For parties to make small-sized special rivets.

Metal cut, bent, crimped, embossed, corrugated; any size or shape, Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 2672.—For a device for placing over the nose to prevent dust from entering the nostrils.

We design and build special and automatic machinery for all purposes. The Amstutz-Osborn Company, Cleveland, Ohio.

Inquiry No. 2673.—For dealers in metal novelties.

For Machine Tools of every description and for Experimental Work call upon Garvin's, 149 Varick, cor. Spring Streets, N. Y.

Inquiry No. 2674.—For machinery for making different kinds of fiber from pine needles.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2675.—For machinery for distilling an extract of essential pine needle oil from the needles.

Patents developed and manufactured, dies, special tools, metal stamping and screw machine work. Metal Novelty Works Co., 43-47 S. Canal St., Chicago.

Inquiry No. 2676.—For machinery for making a fabric from the fiber of pine needles.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2677.—For machines for stamping names on small aluminium plates.

IDEAS DEVELOPED.—Designing, draughting machine work for inventors and others. Charles E. Hadley, 584 Hudson Street, New York.

Inquiry No. 2678.—For the manufacturers of the "Little Giant" wood planer.

WANTED.—American agencies on commission lines for Australia or South Australia. References: J. B. Pitcher. No. 2 A. M. P. Buildings, King William Street, Adelaide, South Australia.

Inquiry No. 2679.—For makers of oil burners for small steam boilers.

PATENT FOR SALE.—Setting instrument patented March 18, 1902. Every machinist needs one. Used for different purposes. Send for circular. Morris Chamberlain, Bartley, N. J.

Inquiry No. 2680.—For a motor cultivator or hoe row.

Press work done at short notice. Blanking and drawing our specialty. Estimates cheerfully furnished. Tools for all work made on premises if desired. Copper, brass and nickel plating. Correspondence solicited. Acme Ball-Bearing Caster Co., Chappaqua, N. Y.

Inquiry No. 2681.—For an automatic press for card printing.

Local agents in power using centers make $5.00 to $10.00 a day handling best specialty of kind in America. Exclusive territory. Particulars for 2 cent stamp. W. S. Raymond, 181 Chestnut St., Chicago.

Inquiry No. 2682.—For makers of typewriter ribbons, papers, etc.

Inquiry No. 2683.—For elevators for hoisting pumps for sand, etc.

Inquiry No. 2684.—For makers of automatic coal diggers or grapplers, which will pick up from 1 to 3 yards of sand or gravel.

Inquiry No. 2685.—For manufacturers of brick press or machines.

Inquiry No. 2686.—For dealers in electric elevators.

Inquiry No. 2687.—For a burner for brazing with crude oil and air pressure.

Inquiry No. 2688.—For manufacturers of cheap motors.

Inquiry No. 2689.—For dealers in electric novelties.

Inquiry No. 2690.—For candy-making machinery, such as lozenges, etc.

Inquiry No. 2691.—For the manufacturers of an attachment for spoons to avoid slipping into dishes, also for the makers of a spoon with a perforated bowl for mixing batter, etc.

Inquiry No. 2692.—For manufacturers of coffee roasters.

Inquiry No. 2693.—For the address of Morton Evans & Co., makers of gasoline traction gear.

Inquiry No. 2694.—For makers of gasoline fuel marine steam engines and boilers 1 to 40 h. p.

Inquiry No. 2695.—For machinery for making a feed brick under pressure.

Inquiry No. 2696.—For makers of hydraulic brick and clay-raking machinery.

Inquiry No. 2697.—For makers of pocketbook rims and clasps.

Inquiry No. 2698.—For manufacturers of double automatic yard gates.

Inquiry No. 2699.—For a 20 to 25 h. p. traction engine for use on country roads for hauling freight.

Inquiry No. 2700.—For manufacturers of cheap clockwork to drive movable paper figures for advertising.

Inquiry No. 2701.—For parties to manufacture special machines.

Inquiry No. 2702.—For manufacturers of paper novelties, such as spoons with hollow handles, etc.

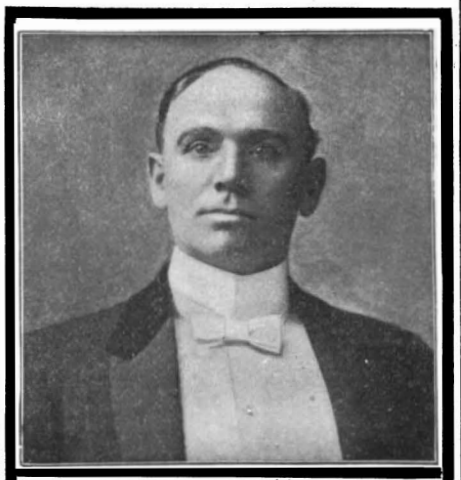
Inquiry No. 2703.—For dealers in second-hand belting.

Inquiry No. 2704.—For manufacturers of small refrigerating plants suitable for residences.

Inquiry No. 2705.—For a gas plant for from 25 to 50 Bunsen burners, also wire and piping.

Inquiry No. 2706.—For a dynamo for 100 to 150 incandescent lights; also an engine for pumping water and running dynamo.

Inquiry No. 2707.—For makers of bathroom appliances.



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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

May 27, 1902,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.

Advertising device, H. L. Beach	701,249
Air brake connection, W. Neil	701,272
Air brake, railway car, F. M. Kreitz	701,205
Air cleansing and cooling device, J. McCreery	701,074
Air compressor, E. Hill	700,927
Air diffuser, S. G. Smith	701,228
Air purifying and cooling apparatus, R. H. Thomas	700,858
Amalgamator, Marquette & Nelson	701,212
Annealing box, J. J. Markey	700,962
Arch, metal, R. Gray	701,034
Asphaltum, extracting and refining, A. F. L. Bell	700,889
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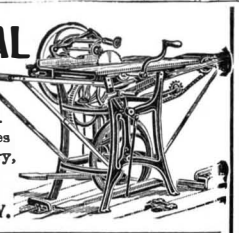

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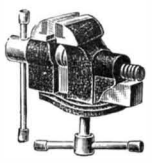

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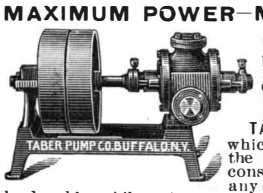

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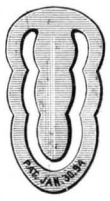

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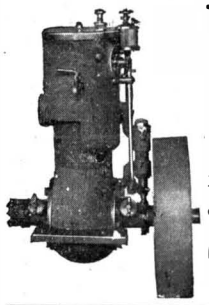

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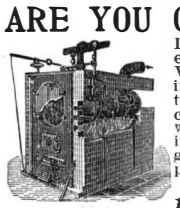

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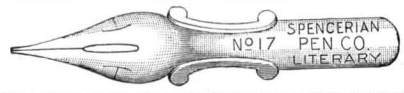

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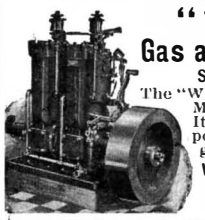

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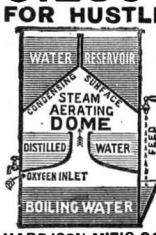

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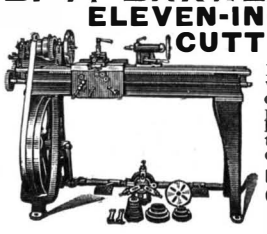

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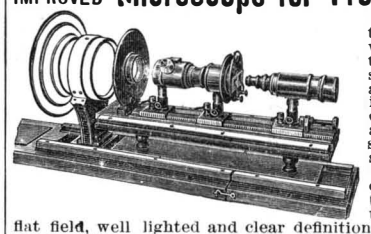

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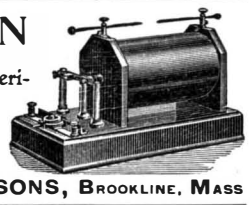

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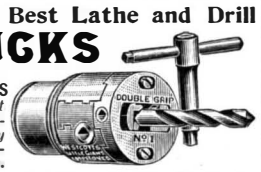

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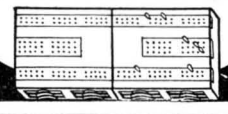

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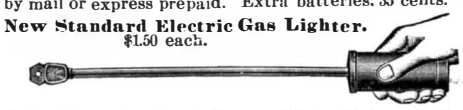

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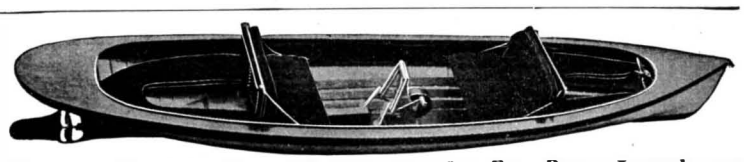

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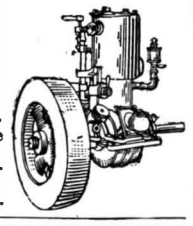

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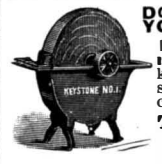

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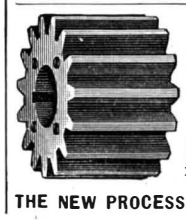

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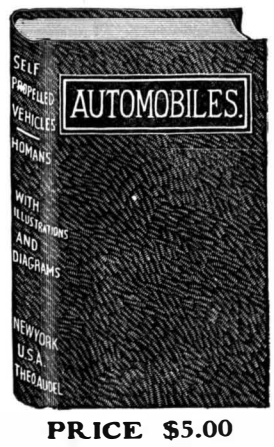

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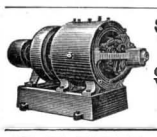

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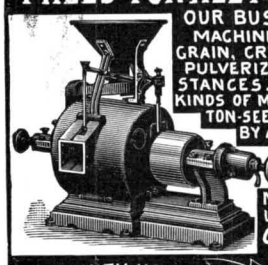

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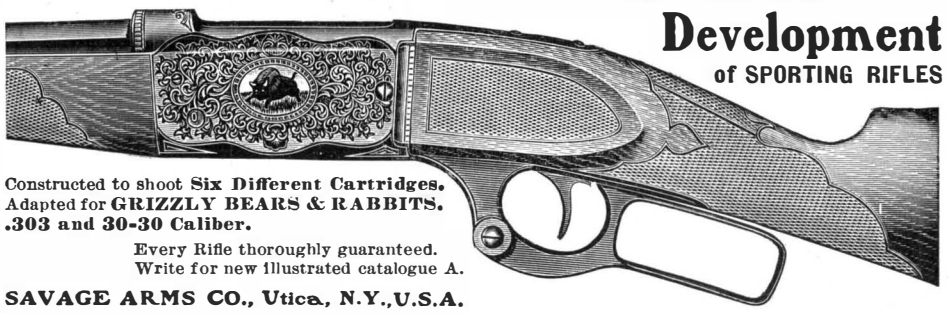

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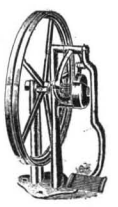

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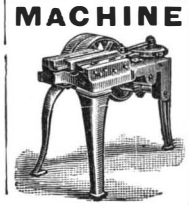

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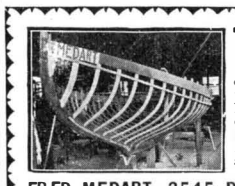

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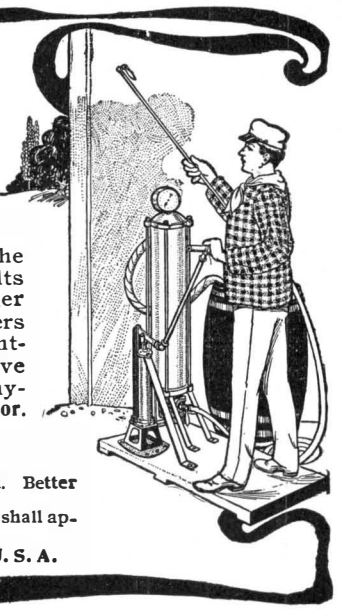

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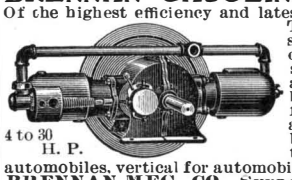

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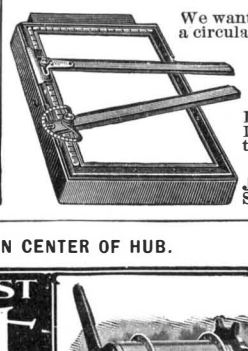

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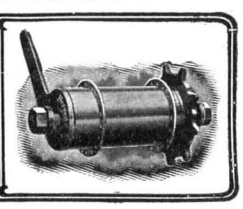

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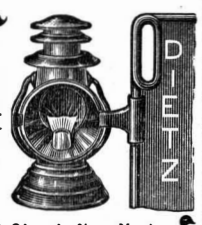

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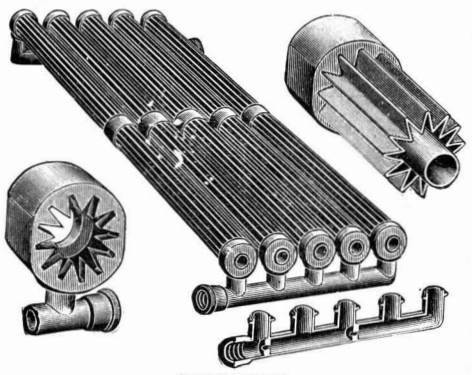

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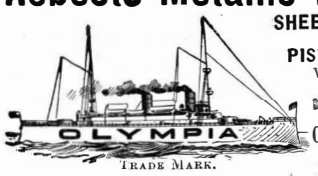

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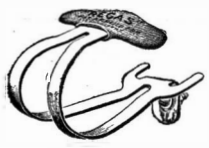

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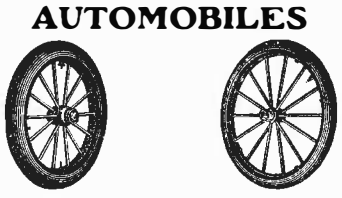

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"Crescent Silk Velvet," for velvet, R. A. Hays	9,160
"Eclipse Hair Tonic," for hair tonic, F. Bauer	9,162
"El Fumeros," for cigars, American Lithographic Company 9,167,	9,168
"Millionaires Club," for whisky, I. Mansbach & Co.	9,170
"Owens' Fragrant Cream," for a toilet preparation, J. C. Owens.	9,163
"Resorcinol," for an ointment, F. Dohmen Company	9,166
"Schaefer's Blood Purifier," for medicine. E. B. Reeber	9,161
"Worcester Quick Freezing Ice Cream Salt," for salt, Worcester Salt Co.	9,171
"XXX Hygienic Soap," for soap, Camden & Philadelphia Soap Company	9,173

PRINTS.

"Atwood Suspender," for suspenders, Atwood Suspender Co.	507
"Climax," for nose guards, D. W. Tait	508
"Darmstadt German Food," for foods, Darmstadt German Food Company	510
"Meier & Schuknecht," for trunks, grips, and valises, Meier & Schuknecht	509
"Men's Apparel," for men's apparel, W. C. Both	506
"Yale Violets for the Breath," for a breath perfume, Graham Drug Co.	511

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

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AUTOMOBILES. By James E. Homans, A.M. New York: Theo. Audel & Co. 1902. 632 pp. 500 illustrations and diagrams. Price $5.

This is one of the most comprehensive works on the subject that has yet been published by an American. It is thoroughly practical and is written in an interesting, untechnical style, quite comprehensible by the novice. The book covers the whole subject, as far as the three powers in use to-day—steam, electricity and gasolene—are concerned, the descriptions of the method of operation of the three types of motors used being especially lucid. After brief prefatory historical data concerning early steam and gasolene carriages, the author gives a description of the modern examples of these types, their construction and various parts. Chapters on running gears, wheels, tires, brakes, etc., contain much valuable information for any one building a carriage or about to purchase one, as do also the excellent descriptions of the various types of carbureters for gasolene motors, and burners and boilers for steam, which are found upon its pages.

THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1902. New York: The Scovill & Adams Company. 1902. Pp. 347, 71. Price 75 cents.

The present number of the Annual shows the progress which has been made in photography during the past year. There have been no remarkable discoveries and no great changes in processes. The illustrations are many and varied, but do not represent any particular school of photography. We notice one very good print in the three-color process, which seems to be gaining in popularity. The articles treat of many subjects of interest to the amateur photographer. Altogether, the Annual is a very attractive and instructive number.

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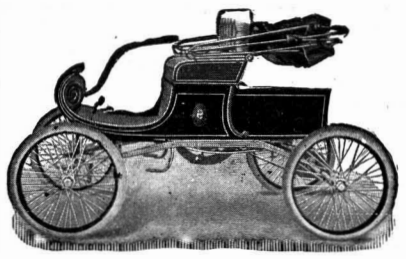

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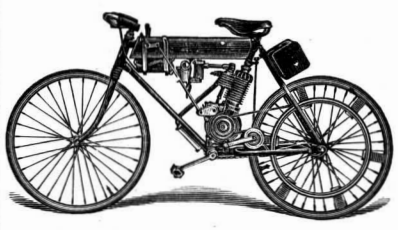

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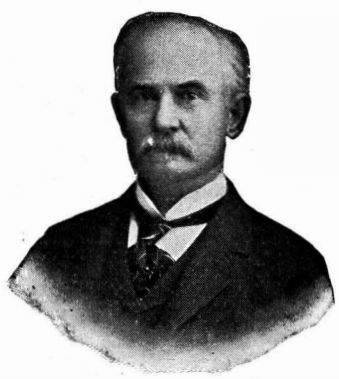

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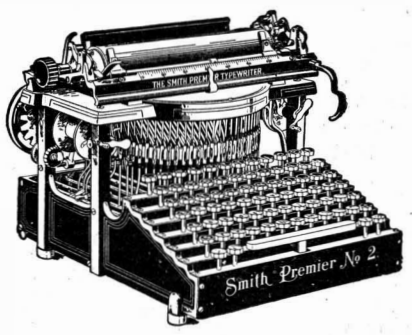

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Notes and Queries.

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References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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(8617) H. N. Co. ask: Can you furnish us with information in regard to dipping small articles in tin (½ tin, ½ lead). A. For tinning small articles, making them bright and smooth, we advise an alloy of 2 parts tin to 1 part lead. The articles should be freed from grease or oil in an alkali bath, washed clean, and dipped in a solution of muriate of zinc and ammonia, made by dissolving zinc to saturation in muriatic acid diluted with half its bulk of water. Add as much sal ammoniac as the solution will dissolve. This solution may be further diluted with water according to the kind of metal by experience. Then dip in the melted solder quite hot, so that it will drip freely. Withdraw slowly and plunge in clean hot water.

(8618) W. L. W. writes: Referring to an article on page 353 of the May '17 issue of the SCIENTIFIC AMERICAN, concerning power lost in flywheels, I beg to offer some suggestions that would better do away with the friction of the atmosphere referred to. As I understand it, this wheel is simply a balance wheel, and is not used as a pulley also. This being the case, would it not have been better to make an airtight casing inclosing the wheel entirely, with an airtight joint at the shaft, and then pump out the air, creating a vacuum in which the wheel would revolve without any atmospheric friction whatever, and the only added friction would be the slight pressure of the packing boxes on the shaft. The same plan could be adopted where the wheel is used as a pulley also by inclosing both the driving and driven pulleys together with the belt in the airtight case. A. The great difficulty of insuring the maintenance of a vacuum in a large space would probably prevent the success of your plan to incase a driving wheel in a box from which the air is exhausted.

(8619) A. B. and others: Several of our esteemed correspondents call attention to the fact that we only allow the calf, in the problem of which we published a solution under Query No. 8606, to graze in one direction; but as the inquiry was how much *can* the calf graze over, we answer this also. The calf can graze over three-quarters of a circle with 400 feet radius. It can then graze over a sector on each side of this of almost 60 deg., or two areas each nearly one-sixth of a circle of 300 feet radius. There remains a figure formed by two sides of the barn and the radii of the last arc, 300 feet. Draw a diagonal of the barn, completing a triangle with these radii. The length of this diagonal is found by the rule for the right triangle. It is a little more than 141 feet. The three sides of the triangle are now known, and the area may be found by the rule as follows: From half the sum of the three sides subtract each side severally: multiply together the half sum and the three remainders, and extract the square root of the product. The area of this triangle is about 22,500 square feet. From this take 5,000 square feet, or half the area of the barn, and add to the remainder the two circular parts noted above. When the problem is solved with the aid of trigonometry, the result is a total of nearly eleven acres. No two are likely to obtain exactly the same results, since the retention or rejection of decimals will affect the result. The highest exactness in the result is to be obtained by employing the methods of the calculus.

(8620) J. H. H. asks: 1. Could No. 32 wire be used for the secondary coil in place of No. 30? A. No. 32 wire would be better than No. 30 in the secondary of an induction coil. 2. If so, would the same weight of wire produce a stronger current? A. The same weight of No. 32 would make more turns on the spool and hence give a longer spark than could be made by No. 30. 3. Could a 108-volt incandescent current in the primary coil be used with good effect? A. 108 volts would be too high a pressure to use in the primary of an induction coil. If such a current is employed, it will be necessary to use a rheostat or choking coil to cut down the current taken by the primary. 4. What size wire should be used to carry the secondary current around a room, to be used in initiatory work in a lodge? A. A wire of the same size as the secondary will carry the secondary current anywhere it is desired to produce an effect.

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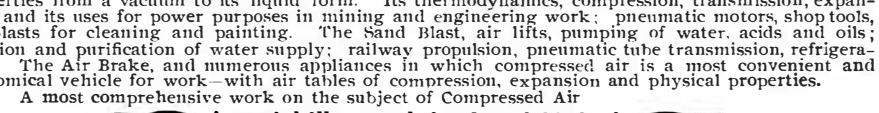

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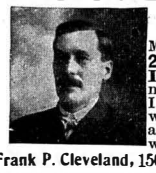

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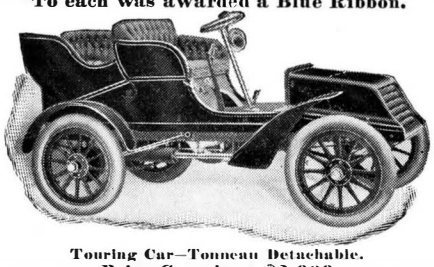

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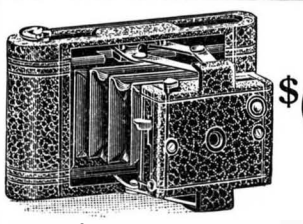

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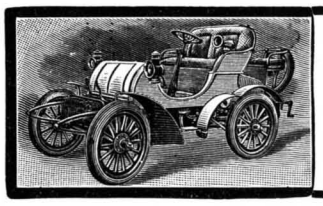

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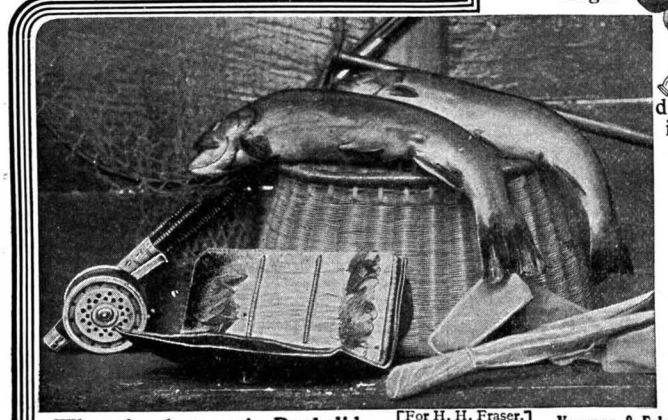

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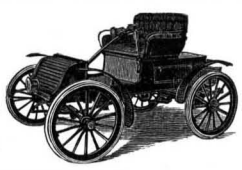

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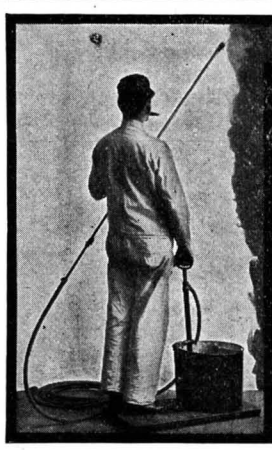

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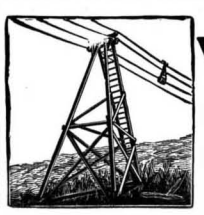

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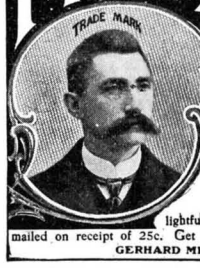

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